JOURNAL

VOLUME 11, NUMBER 2 • FEBRUARY, 1955

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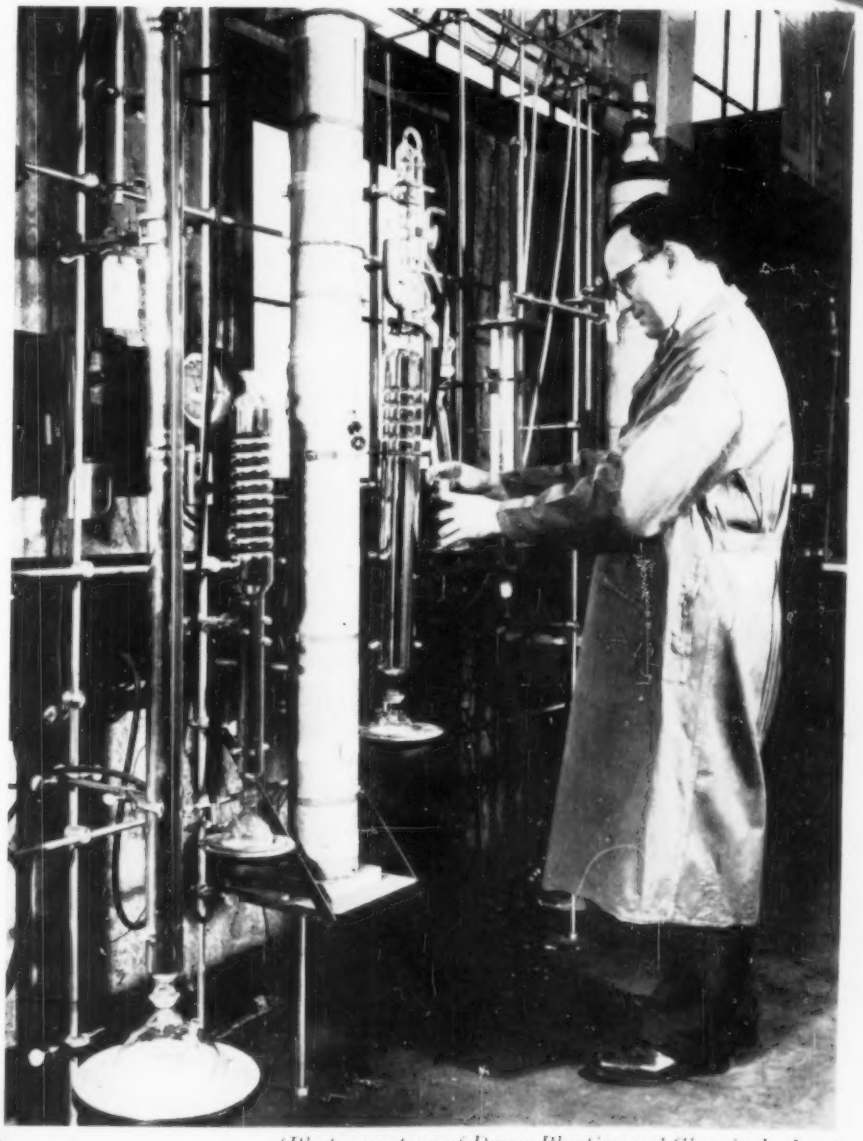
FEB 2 1955

New Plastics With New Properties

And Improvements in Familiar Plastics Begin in the Laboratory



(Photo courtesy of Durez Plastics and Chemicals, Inc.)

PUBLISHED BY THE SOCIETY OF PLASTICS ENGINEERS, INC.

Crystal brush backs made from Lustrex Hi-Flow 55 are examined as they come from the mold. Note perfect clarity.

"WE CLIPPED 15 SECONDS off the cycle by changing to LUSTREX HI-FLOW 55!"

How Monsanto's soft-flowing styrene solved unusual problem for Autograf Brush & Plastic Company

In creating a new one-dollar line of crystal hair brushes, Autograf's first requirement was absolute clarity.

Toughness, freedom from strain and low cost were vital.

According to Autograf's production and development manager, the original materials tried on the job showed flow lines and often split under the tremendous stress needed to inset the nylon bristles.

"Because of the better moldability of Lustrex Hi-Flow 55, we got the perfect clarity we wanted. And as soon as we went into production, other advantages were also apparent.

"The Monsanto material flows about 20° cooler than the original compounds we used. It sets faster and we're clipping as much as 15 seconds off our 2-minute cycle. That's quite a saving. Needless to say, we're delighted."

For proof that Monsanto's soft-flowing styrene compound can improve the quality and sales appeal of the products you mold, try Lustrex Hi-Flow 55 on your next job. Write Monsanto Chemical Company, Plastics Division, Dept. SP-2, Springfield 2, Mass.

Speed cycles and cut costs with HI-FLOW 55

MONSANTO

MONSANTO LUSTREX Styrene Plastic

SPE JOURNAL

VOL. 11 February, 1955 No. 2

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New "Stationette"—reinforced plastic body by Bassons—is seen as answer to needs of small retailers, suburban families. It has three wheels, rear motor, and complete reinforcing structure molded directly into the underhalf, making body repair costs infinitesimal. The light-duty delivery vehicle is 53" high, 64" wide, 106" long, has 110 sq. ft. of cargo space, and a speed of 40-45 miles per hour.

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★ **telephone handsets**

★ **instrument housings**

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RICH . . . BLACK
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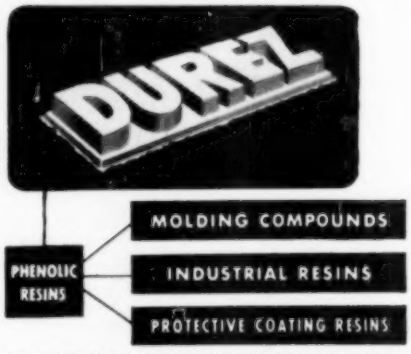
Specifications and further details gladly supplied on request



PHENOLIC PLASTICS FOR THE NEW COMPETITIVE ERA

Plastics Program Set for University of Wisconsin Engineering Institutes In March

A two day program on Industrial Plastics is being offered on March 14 and 15 at the University of Wisconsin in Madison. This is one of several engineering programs being offered this year. Registration is fifteen dollars, and a certificate of attendance is awarded at the end of the program.

Monday, March 14, talks will be given on: Polyethylene, uses and methods of application; Metallizing and Finishing of Plastics; New Developments in Silicones; Plastic Tooling; and a dinner talk on Plastics Industry in Wisconsin. On Tuesday, talks are to be on: Polyesters; New Plastic Processes and Their Implications; Epoxy Plastics; Color in Plastics. Also included will be a talk on Thermosetting Laminates and Materials.

Companies providing speakers include Bakelite, F. J. Stokes, Dow-Corning, Ren-ite Plastics, DuPont, Shell Chemical, Decar Plastics and the University of Wisconsin staff.

For further information write to Dept. SPE, The University Extension Division, University of Wisconsin (attention of Ralph D. Smith) Madison, Wisconsin.

Correction in "Creep of Acrylic Glazing" Article

There is an error in figure 6 in the article on "Measurement of creep of acrylic glazing plastics exposed to temperature gradients" in the December 1954 issue of the SPE Journal. The dashed line for the 1000 lb. in.^{2} stress does not have the correct slope as shown in Table II. The slope of the line in figure 6 is calculated as 0.0002 whereas Table II gives a value of 0.0008. The value in Table II is correct.

The error was probably introduced in the expansion from the original curve. The notebook shows that the 5-hour value for elongation is about 0.50 percent and the 50-hour value about 0.59 percent. This means that the left side of the line in figure 6 should be lower on the elongation axis.

New D-M-E Mold Bases

The largest single group of improvements ever incorporated into the design of D-M-E Standard Mold Bases took effect January 15, 1955 with the release of D-M-E's new 182 page catalog.

The completely new features to be incorprated in the 12", 15" and 18" wide series effective January 15, 1955 are:

1. Clamp slots to save platen space. 2. New widths to fit more machines. 3. More room for waterlines. 4. Rigid construction with less parts. 5. Welded stop pins prevent interference.

Due to the above improvements in design, D-M-E Master Layouts for Standard Mold Bases which are still unused by mold designers will become obsolete. New "black on white" as well as transparent Master Layouts which conform to the new designs are available at all D-M-E Branch Offices. Mold designers are cautioned against using the obsolete Master Layouts for molds which are to be ordered after the effective date of January 15, 1955.

• Herbert S. Spencer has retired after nearly 30 years with Durez, or perhaps we should say semi-retired. He has left the post of Advertising Director, but will continue to handle several of the Durez accounts. Mr. Spencer was one of the organizers of the SPI, and was founder and first president of the Plastics Pioneers. Your editor —and I am sure the whole plastics industry—wish Herb Spencer the best of everything for many years to come.

Clark R. Simmons, who has been with Durez 17 years, succeeds him as Advertising Director.

• A man may be described by what he does—and that makes most SPE members **"plastics engineers."** In a legal sense, however, we are like the fellow who lost his birth certificate—he could argue all day but the judge could rule that he did not exist. Fantastic, sure—but it has happened.

To be an "engineer" in a legal sense, requires state registration and certification in many states, and in these states one can get into legal difficulty if he uses the word engineer in connection with his work unless he has that license.

The SPE, which is the one organization devoted to the welfare and up-grading of the individual, is taking the lead, as it should. Final recognition of plastics engineers as a class is legal recognition, and the end of the long period of growth and development that any new professional group must undergo.

Legal recognition is simply the last step in a long series of steps. The big first step is behind us, we do exist as a well-differentiated and highly-skilled technical group within a well-defined industry. The next steps are, first, a clear-cut verbal definition, acceptable to law and industry, of "plastics engineer." This is in process and was the subject of a report at the 11th SPE conference. Second is the establishment of academic course-work in recognized institutions, leading to a degree in Plastics Engineering, or a degree in Engineering, with specialization in plastics. This degree is probably a minimum requisite for legal existence as a class. Progress in this direction has been made with the recent establishment of a four year degree course in Plastics at Lowell Institute, and a three-year certificate course at Newark College of Engineering (as reported in detail on pages 34 and following) as well as the established graduate program at Princeton. SPE has worked with, and encouraged, these programs.

Legal recognition is an eventual necessity, but must wait upon such degree programs. Licensing of engineers and legal restrictions on the unlicensed have made great progress in the last ten years—so much so that SPE could not use its own name in some states if our formation had not preceded the laws!

Legal recognition will come, and every member should do what he can to help establish this. Such recognition will up-grade not only the SPE, but the whole industry, and pushing this program deserves every support and encouragement from the industry that it will benefit.

Only a COMPLETE Plant
can offer
a COMPLETE PLASTICS SERVICE
• VIRGIN INJECTION and EXTRUSION MOLDING COMPOUNDS
• CUSTOM COMPOUND YOUR MATERIALS
• COMPLETE EXTRUSION FACILITIES for FLEXIBLE and RIGID MATERIALS
• DRYCOL: Perfected coloring medium for on-the-spot in-plant dry coloring all plastics
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NICOFORM ELECTROFORMED Molds

In this process the cavities are formed of a hard (45-50 R.C.) nickel cobalt alloy. There is no heat-treating, no stoning or finishing of the cavity. All the finishing is done on the master before the cavity is formed.

Consequently the cavities are the EXACT SIZE of the master used to produce them. Thus greater accuracy can be secured in irregular shapes such as plastic gears.

This process makes possible the reproduction of surface texture with amazing fidelity. Many molds now become practical which were formerly too costly or not practical to make by machining.

We will supply cavities and other mold parts ready for installation in a mold base. New applications are continually being found. Perhaps your problem can be solved by this new process.

Send now for **new** Brochure with detailed explanation of ELECTROFORMING, the new and better method of making molds.

ELECTROMOLD CORP.

143 ENTERPRISE AVE. . . . . TRENTON, N. J.

Industrial Literature

Marblette Epoxies

A permanent reference folder on the properties and applications of Marblette epoxy resins is being distributed by the Marblette Corp., 37-21 Thirtieth St., Long Island City 1, N. Y.

Copies of the folder are available from Dept. SPE, The Marblette Corp., on request to the home office. Working samples and production aids are available from the company's headquarters or from branch offices in Chicago, Los Angeles, Detroit, Montreal, Wichita, and Havana.

Irradiated Ethylene

Complete information on its Agilene-HT, irradiated polyethylene, is detailed in a new data sheet, just published by the American Agile Corporation, P. O. Box 168, Bedford, Ohio.

Copies of this free literature may be obtained from Dept. SPE, the American Agile Corporation, P. O. Box 168, Bedford, Ohio.

Low-Priced Acrylic

Announcement of the commercial availability of a new, lower-priced cast acrylic sheet has been made by Rohm & Haas Company, Philadelphia plastics manufacturer. Called Plexiglas R, the new plastic sheet ranges from 10% to 25% less in price, depending on thicknesses and sizes, than the company's present standard Plexiglas sheet which it will continue to supply.

A new booklet, "Glycerine Alkyds Tailored To Need" is available without cost from the Glycerine Producers' Association. This 20-page reprint of articles by Charles R. Bragdon, engineer and consultant in the field of organic coatings, will be of practical value to users of alkyds as well as resin manufacturers. It assists in selecting the resin that best meets the specific needs of each coating requirement.

A copy of this booklet "Glycerine Alkyds Tailored To Need"—may be obtained by writing to Dept. SPE, the Glycerine Producers' Association, at 295 Madison Avenue, New York 17, N. Y.

A new booklet, "Cellosolve and Carbitol Solvents," has just been published by Carbide and Carbon Chemicals Company, a Division of Union Carbide and Carbon Corporation. This booklet describes in detail the nine commercial glycol-ethers sold by the Company.

Copies of this booklet, "Cellosolve and Carbitol Solvents" (F-4765), are available from Dept. SPE, Carbide and Carbon Chemicals Company, 30 East 42nd Street, New York 17, New York.

Which LAMINAC® polyester resin should you use?

HOW? and WHERE?

Here's complete technical data on each of Cyanamid's LAMINAC resins—yours for the asking. Also a summary technical data sheet itemizing popular applications for the standard LAMINAC resins.

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AMERICAN CYANAMID COMPANY, PLASTICS & RESINS DIVISION
32 Rockefeller Plaza, New York 20, New York

☐ Please send summary sheet, listing standard resins and uses

☐ Please send data sheet on the LAMINAC resins appropriate for the following proposed product or type of application_____

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New Sarcotrol Unit automatically maintains uniform roll temperatures

Temperature variations across the faces of water-jacketed cylinders ... so often the cause of production slow-downs because of product imperfections . . . can now be completely eliminated with this new Sarcotrol Heating and Cooling Unit.

By recirculating temperature-controlled water through roll jackets at high velocity, Sarcotrol maintains an even temperature across the entire face of the roll. You can increase production and AT THE SAME TIME MAINTAIN QUALITY.

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Operation is simple and entirely automatic. One knob changes temperature control setting. Controlled temperature is continuously indicated on easy-to-read dial.

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FASTEST PRESS OPERATORS *WANT IT!*

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Don't be fooled! IT ISN'T SIZE— IT'S Quality THAT COUNTS

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Sample Can	$2.00
Unbroken Gross	$197.40
Unbroken Dozen	$18.00

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Industrial Literature . . .

World Plastics Fair

Publication release of a 40-page Exhibitor Handbook has been announced by the World Plastics Fair and Trade Exposition to be held in Los Angeles, California, April 6-10, 1955.

Copies of the handbook, which describes all details of the show, are available to interested companies by writing to Philip M. Kent, managing director of the Fair, 8762 Holloway Drive, Los Angeles 46, California.

Durez Bulletin on Phenolics

Increased usage of phenolic resins throughout the rubber industry has prompted Durez Plastics & Chemicals, Inc., phenolic specialists for 33 years, to compile a new bulletin on the subject. This six-page pamphlet points out that the development of new resins, new techniques and greater experience has resulted in a continually increasing market.

Copies may be obtained by writing Dept. SPE, Durez Plastics & Chemicals, Inc., North Tonawanda, New York, and requesting, "Durez Resins In The Rubber Industry."

Carbide and Carbon Reduces Price

A price reduction of 20 cents per pound on Cellosize hydroxyethyl cellulose has been announced by Carbide and Carbon Chemicals Company, a Division of Union Carbide and Carbon Corporation. The products involved, all low salt content powders, are designated Cellosize hydroxyethyl cellulose WP-09, WP-3, WP-40, and WP-300.

Teflon Booklet Available

A 60 page booklet on Teflon is available on request from Dept. SPE, E. I. duPont de Nemours, Public Relations Dept., Wilmington 98, Delaware.

Mycalex Builds Mica Plant

The world's first synthetic mica plant, the beginning of a new industry which, it is hoped, will eventually reduce U. S. dependence on India for the highly strategic material, is under construction at Caldwell, N. J.

The new company, the Synthetic Mica Corporation, is scheduled to begin production early in 1955, according to Jerome Taishoff, president of the Mycalex Corporation of America, the parent firm. Estimated annual output of the new plant will be 1,000 tons of high grade synthetic mica, about 5-10% of the nation's current requirement.

More than 90% of the high grade strategic mica used in this country today is imported from India. It is conceivable that, in time of war, this important source of the critical material might be cut off.

"Synthetic mica is actually a new engineering material," explains Mr. Taishoff. "In many respects it is a better material than the natural mica that must travel half way around the world before it becomes an integral part of our national defense."

The plant is being built without government assistance by the Mycalex Corporation of America, and will function as a wholly-owned subsidiary.

Thiokol Polymers

Several trial formulations and properties of cold casting compounds based on "Thiokol" Liquid Polymer LP-2 are described briefly in a four-page bulletin issued by the Thiokol Chemical Corporation.

The bulletin is available on request from Dept. SPE, Thiokol Chemical Corporation, 780 North Clinton Avenue, Trenton 7, New Jersey.

large

55-gallon drums one-piece molded from BAKELITE Polyethylene are designed to fit in standard fiber, plywood, or steel overpacks. Chemically inert, they resist acids, caustic soda solutions, electrolytic fluid. Resilient, non-shattering, lightweight, they increase safety, cut shipping costs.

small

Tubes and bottles molded from BAKELITE Polyethylene dispense their chemical and pharmaceutical contents when squeezed. Inherently flexible, polyethylene needs no plasticizer. It won't contaminate contents. Tube ends are closed by heat-sealing.

thick

Coaxial cable has thick layer of BAKELITE Polyethylene around center conductor and covered by outer conductor. Tough, flexible, and possessing excellent electrical insulating qualities at high frequencies, polyethylene insulates conductors and keeps them correctly spaced. Other extrusions include belts, tapes, tubes, farm water pipe.

or thin

Liquids are being packed in laminations of cellophane or foil with film made from BAKELITE Polyethylene. Advantages: added toughness and tear strength, heat-sealing to a strong, watertight bond, and resistance to food and other chemicals.

add a new dimension to product planning—

BAKELITE TRADE-MARK **Polyethylene**

Open a new range of performance features for your product. Give it advantages that mean greater sales. Take your pick of fabrication methods—injection molding, extrusion, calendering, coating, vacuum-forming. BAKELITE Polyethylene is packed with possibilities—and it's in plentiful supply right now. The first step in your planning is to learn more about it by writing Dept. AI-43.

BAKELITE COMPANY, *A Division of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N. Y.

In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Belleville, Ontario

NEW

WATSON-STILLMAN PE-64

High-speed preplasticizing type production machine

From hydraulic machine headquarters comes this latest advance in injection molding machines, with a list of specifications that defines a new standard of performance.

Check and compare them now. Remember, too, that Watson-Stillman makes the "Completeline" of injection molding machines to meet every need of the plastics industry. Whatever your production requirements may be, it will pay to get in touch with Watson-Stillman first.

SPECIFICATIONS

W-S PE-64 Preplasticizing Type Injection Molding Machine

INJECTION RATE	1420 cu. in. per min.
PLASTICIZING CAPACITY	200 lbs. (polystyrene) per hr.
DIE SIZE	25" x 45"
CLAMPING CAPACITY	425 tons
DIE THICKNESS (Min.)	16"
STROKE	24"
DAYLIGHT OPENING	40"
HORSEPOWER	55

W-S HYDRAULIC

YOUR NATIONAL OFFICE

Statement of Assets and Liabilities

June 30, 1954

ASSETS

CURRENT ASSETS			
Cash—in Banks	6,700.32		
Petty Cash	235.09		
Total Operating Cash		6,935.41	
Cash Reserved		10,759.97	
Accounts Receivable—Sections		69.73	
Accounts Receivable—Advertisers	1,596.54		
Less: Reserve for Bad Debts	300.00	1,296.54	
Advances—1955 Conference		206.95	
Total Current Assets			19,268.60
CAPITAL ASSETS			
Furniture and Fixtures		2,818.73	
Less: Reserve for Depreciation		2,023.38	
Total Capital Assets			795.35
PREPAID ITEMS			1,552.50
Total Assets			21,616.45

LIABILITIES AND SURPLUS

CURRENT LIABILITIES		
Accounts Payable—Sections	2,612.77	
Accounts Payable & Accrued Expenses	4,404.70	
Total Current Liabilities		6,417.47
DEFERRED INCOME		
1954 Conference		4,269.57
RESERVES		
Contingency Reserve	10,000.00	
Research Reserve	759.97	
Total Reserves		10,759.97
SURPLUS		
Balance—Cumulative Deficit July 1, 1953	1,984.35 (RLD)	
Gain on Operations—July 1, 1953—June 30, 1954	2,153.79	
Balance June 30, 1954		169.44
Total Liabilities & Surplus		21,616.45

Statement of Income and Expenses

July 1, 1953 to June 30, 1954

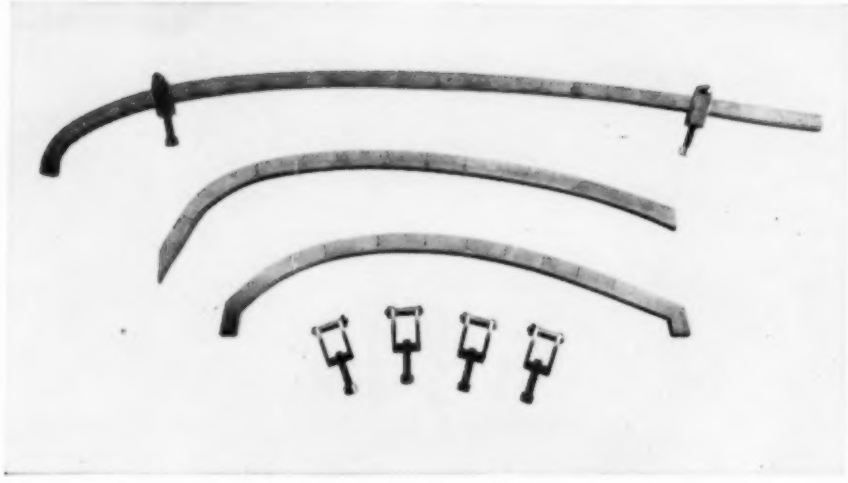
INCOME			
Dues		19,429.72	
Fees		3,361.97	
Convention 1953		5,939.25	
Miscellaneous		685.31	
Magazine—Advertising		17,688.80	
Subscriptions		753.52	
Total Income			47,798.57
EXPENSES			
Salaries		11,467.26	
Office		2,446.87	
Supplies		2,393.87	
Postage		1,205.66	
Depreciation		526.24	
Travel		1,202.28	
Prize Paper		171.11	
Refunds		68.50	
Office Relocation		848.99	
Miscellaneous		1,187.24	
Magazine			
Printing	18,319.28		
Postage	612.18		
Cash Discounts	316.59		
Salaries	1,015.21		
Miscellaneous	561.53	20,824.79	
Transfer to Reserves		3,361.97	
Total Expenses			45,644.78
Gain On Operations July 1, 1952 to June 30, 1954			2,153.79

P. L. Underwood

Executive Secretary

Plastiatrics

DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION



Bending Test Forms and Clamps.

NEW TECHNIQUE OF STRESS MEASUREMENT DEVELOPED FROM STUDY OF POLYSTYRENE BEHAVIOR

In Plastiatrics, as in medicine, sound diagnosis is essential to correct treatment and the cure of problems. That's why The Dow Technical Service laboratories have developed a simplified test procedure for the study of the *crazing* of molded polystyrene . . . a condition which may result from misunderstanding or improper application of a molded plastic part. Of significance to engineers and plastics molders, the new data on polystyrene's "critical elongation" is of fundamental importance in product design and in predicting field service life.

What is Crazing?

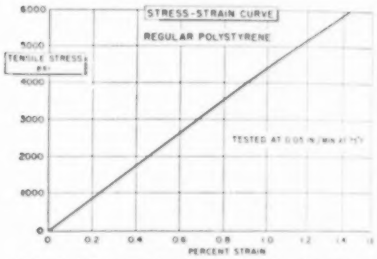
Crazing is the development of fine cracks on or under the surface of molded plastics. Whether or not it progresses to serious proportions is dependent on several variables of exposure and applied stress over a period of time. "Solvent crazing" may be derived from the chemical action of a wide variety of reagents. "Stress crazing" may result from mechanical loading, shock, thermal conditions, or from the molding operations.

Simple Test Developed

To maintain standard conditions while handling of immersing specimens in a variety of reagents, a simple, portable bending form was developed. It's designed to provide a constantly changing radius of curvature and corresponding stress as well as strain in the test specimen. Percent elongations can be calculated accurately and varied over a wide range while cold flow is virtually eliminated regardless of the length of time needed for the test. By close visual examination of the stressed specimen in bright light, it is possible to observe the minute cracks and ascertain the magnitude of the crazing in relation to the amount of stress. Excellent correlations of results have been established with critical elongation values taken from conventional testing equipment, as well as with field tests of molded products. Effects of time, temperature reagents, and exposure can be studied in detail.

Practical Uses for Engineering

From the data, the design engineer can more definitely predict stress behavior of molded polystyrene parts. For example, studies on the effects of various milk products on tumblers indicate varying degrees of useful life. Lactic acid is found to have less affect on weakening polystyrene than butterfat has. Test results established critical stress for skim milk at 750 p.s.i. as against 450 p.s.i. for cream. When the tumbler is subject to very hot water in the presence of cream (butterfat), critical stress is further depressed (to about 200 p.s.i.) leaving little room for internal molding stresses or mechanical leading stresses resulting from stocking, rough handling or dropping. Thus, it becomes possible to predict the margin of residual stress which will result in satisfactory tumblers . . . or to forecast potential crazing difficulties.



Typical Stress-Strain curve of polystyrene.

Free Bulletin Offered

A considerable amount of data on this test method has been compiled and published in a bulletin entitled "The Crazing of Polystyrene." A copy will be sent free upon request. Write to Plastics Sales Department PL 454Z, THE DOW CHEMICAL COMPANY, Midland, Michigan.

DOW POLYSTYRENE FORMULATIONS:

- Styron® 666. . . Dow general-purpose polystyrene.
- Styron 688 . . . for controlled flow and controlled pressure distribution in the mold cavity.
- Styron 777 . . . for medium-impact strength.
- Styron 475 . . . for high-impact strength and high elongation.
- Styron 475 sheet . . . for vacuum or pressure forming.
- Styron 480 . . . for extra-high-impact strength.
- Styron 700 . . . for high heat resistance.
- Styron 637 . . . for improved light stability.

you can depend on DOW PLASTICS

DOW

A SYMPOSIUM . . .

rubber resin blends

Edited by Frank A. Martin

The Hoover Co., N. Canton, Ohio

The fields of rubber and plastics have always been closely allied in processing methods. For the past several years this alliance has been growing even closer in that the rubbers and plastic resins are being blended together. Because of this growth in the utilization of rubber-resin blends it was considered appropriate for the Akron Rubber Group and the Cleveland-Akron Section of SPE to conduct a joint symposium so that the latest developments in this field could be presented to the members of both groups. This symposium was held at the Mayflower Hotel on October 23, 1953. The various blends were first discussed by eminent workers in the field, and following these talks the speakers answered questions submitted by the audience. Dr. Fred Stavely of Firestone Tire and Rubber Co. served as the chairman of the meeting, introducing the speakers, and conducting the panel discussion.

Blends of Styrene-Butadiene Resins with Rubbers—Rigid Compounds

C. R. Holt

Marbon Corporation

The uncompounded styrene-butadiene resins are not especially useful as end-product materials. Their value is entirely in their use as compounding resins with the various rubbers, with the resin used as a modifier and reinforcing agent for the rubber, or with the rubber used in small amounts to modify the basic properties of the resin.

This latter type of compound, where the resin is 60% or more of the total resin-rubber content, is usually rigid or semi-rigid and is the kind of blend which will be discussed here.

The general characteristics of these materials include excellent impact-strength, high tensile and hardness, good electrical properties, low specific gravity, bright colors and good low-temperature properties. Practically all machine operations, such as sawing, drilling, buffing and sanding can be readily performed. Resistance to inorganic chemicals can normally be considered very good.

The following values are typical:

Tensile	3000-6500
Elongation, %	100-1
Shore D	60-80
Impact, notched Izod	100-10
Specific Gravity	1.00-1.15
Flexural Strength	6-12000
Heat Distortion, °F.	105-175°F.
Brittle Point, °F.	-40 to -60

Since these are blends of slightly unsaturated resins and somewhat more unsaturated rubbers, they are vulcanizable and must be cured to obtain the optimum physical characteristics. Cure time and temperature are dependent upon the curing ingredients used. Uncured blends are of little practical significance. In appearance they resemble the cured compound but do not have the tensile or flexural strength of the cured stock.

Each compound is naturally made to fit the requirements of the particular end-use. Physical properties are controlled by the type and amount of plasticizer and filler, the softening point of the resin, and the sulfur content.

The high-styrene resins can be plasticized with a number of types of rubber plasticizers such as certain esters, chlorinated materials, coumarone-indene resins, etc., but natural and synthetic rubbers are by far the most interesting. GR-S and the high nitrile Buna N's are especially compatible; natural rubber and neoprene are also very good. GR-I does not seem to be compatible.

The most outstanding property of these blends is their high impact-strength. Small amounts of rubber (10-20%) give excellent impact-strength with only minor sacrifices in hardness and other properties. Increasing the elastomer content continues to increase impact-resistance but gradually lowers hardness, tensile and modulus to the point of a leather-like rather than a rigid compound.

The nature of the rubber used should be considered for several factors: the low-temperature brittle point of the vulcanized blend seems to be dependent upon the

freeze point of the rubber and is apparently independent of the amount of rubber present.

Polybutadiene is an excellent plasticizing rubber for good low-temperature properties although natural rubber and GR-S will give brittle points of -40 to -60°F. Stocks designed for oil-resistance would naturally call for Neoprene or Buna N as the modifying rubber. Electrical molding compounds would call for the proper grade of GR-S or natural rubber in order to maintain the excellent electrical properties of the styrene-butadiene resin.

Reinforcing pigments such as the carbon blacks are not generally used although up to 75 parts of an SRF on furnace black will improve tensile and compressive-strength properties.

Non-black fillers do not reinforce these blends and should be used only for cost reduction or processing advantages. For removal of a piece from a hot mold, for example, some loading is advisable to reduce shrinkage and to facilitate handling. Cotton or cellulose flock, long-fibre asbestos and wood-flour are good in this respect. Diatomaceous silica is excellent for loading compounds designed for chemical resistance. For reducing cost, whiting and clay or the soft blacks may be used. Practical rigid compounds with an Izod impact-value of nearly one foot pound may contain as much as 200 parts of clay on a 50-50 blend of resin and rubber.

None of these compounds have a sharp melting-point. They will soften to a plastic condition at temperatures of 130-200°F., depending upon the softening point of the resin and the sulfur content of the blend. Increasing sulfur up to 12-15 parts will increase the hardness and the heat-distortion temperature at the expense of impact-strength and darker color. Of two stocks equal in hardness and modulus, the one higher in resin and lower in sulfur will usually have the higher impact-strength.

A similar use of high sulfur with blends of styrene-butadiene resins and rubbers is in the compounding of ebonite or hard rubber. Replacement of part of the rubber with the resin permits the use of less sulfur with consequent lighter color, reduced cure time, and increased impact-resistance and softening-point. Thick sections can be cured in less time without porosity or blowing.

It has been mentioned that vulcanization is necessary to bring out the full properties of these blends but there are several exceptions to this—combinations of styrene-butadiene resin and Neoprene S are very tough and will show tensiles as high as 4000 lbs. per square inch in the uncured state. Another modified high-styrene resin with a high softening-point is very compatible with the various synthetic rubbers and uncured blends show excellent impact-strength values with high heat-distortion temperatures and low brittle-points.

The mixing and processing of these blends is much the same as that of conventional curing compounds and any conventional rubber equipment can be used. Average mixing temperature will be 200-225°F. to permit softening and fluxing of the resin with the rubber. One special precaution must be taken in the handling of the mixed compound—the uncured stock is usually very hard or even brittle and preheating of the stock blanks before molding is necessary in most cases. A satisfactory method for curing in positive or semi-positive molds is to granulate the uncured stock and load the mold with a weighed charge of granules.

For calendering sheet-blanks, the raw stock can be preheated prior to placing it on the warmer-mill or the granulated compound can be charged directly onto the warmer. The calendered stock is then usually plied-up in the mold and press-polished into sheets for post-forming operations.

As mentioned, cured compounds are very flexible when hot and must be cooled before they can be handled. Larger pieces are best cooled on forms which allow dimensions to be accurately maintained. Smaller articles can simply be air or water cooled. Some types of molded items can be cured flat and later reheated and shaped over forms. A cured resin-rubber blend is too thermoelastic, however, to be remolded into an entirely different shape where the stock must flow in the mold.

Typical applications for these blends include athletic and crash helmets which give protection to the wearer, are light in weight, colorful, and do not absorb moisture. Desk pads and automotive door-pads can be made scratch-resistant and in bright colors. Shipping containers for pharmaceuticals are strong and light; pipe-fittings, acid containers and vent-ducts all illustrate the good chemicals resistance of these cured blends.

An appropriate balance of rubber, sulfur and filler content can usually be made to meet most hardness, impact, cost, heat-distortion and processing requirements.

Blends of Styrene-Butadiene Resins with Rubbers Non-Rigid Compounds

Harold S. Sell

Goodyear Tire and Rubber Co.

Styrene-butadiene copolymer resins have gained widespread acceptance as a rubber compounding ingredient since their first introduction to the trade following World War II. These copolymer resins, containing 80% to 90% styrene in combination with butadiene, are hard, clear, brittle resins and of very limited value as resins themselves. However, they are compatible with natural rubber, GR-S, and nitrile rubbers and impart desirable properties to be enumerated later in the discussion. They are of limited compatibility and use with chloroprene rubbers and incompatible with the butyl rubbers.

The properties imparted by the incorporation of high styrene copolymer resin into rubber are as follows:

1. They increase hardness.

2. They increase stiffness.
3. They improve the poor gum properties of synthetic polymers; specifically tensile strength, elongation, and tear strength.
4. They improve abrasion resistance.
5. They promote good hot tear strength.
6. They improve the electrical properties of any rubber into which they are incorporated.
7. They do not materially alter the brittle point of the rubber into which they are incorporated.
8. They are excellent aging materials and their incorporation improves the aging of natural rubber.

In addition to the improvements in physical properties, they serve several other useful functions in the compound. Among these are:

1. They are the lowest specific gravity, non-discoloring and non-staining reinforcing material available.
2. They kill the nerve and reduce the shrinkage of the batch.
3. They act as plasticizers and processing aids at stock processing temperatures.

Incorporation of the resins into the rubber batch is readily accomplished on conventional rubber equipment. Commercial resins have been developed which disperse upon direct addition in the Banbury or when incorporated directly into the stock on warm mill. In most cases the resin will disperse while the pigment is being incorporated into the batch. In some cases where short, cool mixing cycles are desired, some manufacturers find it desirable to premasterbatch the resin and rubber on hot equipment and use the masterbatch form on cold mill.

All existing applications for high styrene reinforcing resins are based upon one or more of the features imparted by the resin, as outlined earlier. A few examples will serve to illustrate this point.

Synthetic leather-type shoe soles consume the greatest volume of resin and utilize the largest number of features imparted by the resin. Their high hardness, while maintaining light color and low specific gravity, the stiff "leather-like" feel, the high tear, the good abrasion resistance of the soles, and the easy processing characteristics of the stock are all obtainable by resin reinforcement.

The **Wire and Cable trade** uses the resin for its excellent electrical properties, GR-S reinforcement, and aid in rapid, smooth extrusions.

Flooring Manufacturers utilize the resin to maintain a high level of hardness, aid processing of the highly loaded stocks, and maintain hot tear to minimize tearing upon stripping from the mold.

Manufacturers of **Molded Items** use the resin for a variety of reasons from its aid in processing and extruding preforms to improve tear strength and control specific gravity.

Recent work indicates that improved **Hard Rubber** can be made by obtaining some of the hardness and stiffness from high styrene resin either at the same or reduced sulfur levels. The resin addition, because of the dilution effect and the inherent unsaturation of the resin, has a tremendous suppressing effect on the exothermic sulfur reaction.

High styrene resin can be used as a partial substitution for balata in many applications such as **Golf Ball Covers.**

There is evidence that high styrene resin assists in obtaining uniformity of blow in such articles as internally blown sponge or soling.

Applications for the resins in the flexible stock field have grown steadily as new ways have been found to utilize the unique properties imparted by resin reinforcement. Their properties challenge you to investigate their use in your products.

Blends of Styrene-Acrylonitrile Resins With Rubbers

Willard de Camp Crater

Naugatuck Chemical Co.

The plastics industry, although far from new, like it's big brother rubber, is growing up very fast. The Paley Report, based on studies made by Standard Oil, Stanford Research, National Production Authority, and others, shows a growth rate from 2.4 billion pounds in 1950, to over 22 billion pounds by 1957 for all plastics. A large percentage of this increase is predicated on the present and the development of new resin and rubber blends with improved characteristics.

Styrene monomer, thanks in part to the synthetic rubber industry, is available at a reasonable price. Polystyrene has a combination of valuable properties and has had a very fast growth rate since 1944. Its deficiencies include brittleness and relatively low softening temperature. To overcome these undesirable properties, other monomers such as acrylonitrile, used in the manufacture of oil-resistant synthetic rubber, were chosen for copolymerization with styrene. These copolymers have found commercial use and have better solvent resistance, heat distortion and impact than polystyrene. However, these polymers lack the toughness on high impact desirable for many applications.

Combinations of styrene-acrylonitrile resins and butadiene-acrylonitrile rubbers provide a marked increase in toughness with little sacrifice in hardness and heat distortion of the unmodified resin. Of the various rubbers

evaluated with the styrene-acrylonitrile resin, butadiene-acrylonitrile has established the desirability of this particular blend.

The ratio of nitrile in the resin-rubber and the ratio of the resin to rubber in the final mixture are but primary variations, and a multitude of secondary variations can be imposed on this already flexible system. Although the system appears simple, in reality it is complex. To obtain both desirable and maximum mechanical characteristics it has been found necessary to tailor make the individual resins and rubbers used in the blends. The series of available molding and extrusion compounds feature:

1. Toughness and good rigidity.
2. Dimensional stability.
3. Decorativeness and functionality.
4. Easy formability.
5. Chemical and strain resistance.
6. Good electrical properties.
7. Low specific gravity.
8. Versatility.

To be more specific, individual blends with high hardness exhibit notched Izod impact strengths of 8 ft. lbs./in., with a corresponding value of about 40 ft lbs./in. for the unnotched Charpy impact at room temperature. New relatively hard blends retain toughness with virtually no loss down to -40°F. and with only a moderate decrease at temperatures down to -60°F. This new material seems unique since the impact values over the entire temperature range are appreciably higher than for other available thermoplastics of equivalent hardness and rigidity. The Izod impact values are between 6 and 7 ft. lbs./in. from -40°F. and are still above 4 ft. lbs./in. at -60°F.

Since it is not necessary to use monomeric plasticizers in the resin-rubber blends, they exhibit excellent dimensional stability at high humidities and at low and high temperatures. As would be expected, the resistance to oils, fats, chemicals, and gasoline is good. The bursting strength frequently correlated with so-called effective tensile strength is superior to many other plastics. This combination of properties is extremely useful for such end products as pipe handling many types of corrosive materials.

One disadvantage is the fact that the blends are opaque and cannot be used where transparency is required. However, a full range of colors can be obtained for most applications.

Preparation of the molding powders based on the styrene-acrylonitrile and butadiene-acrylonitrile blends has been accomplished in conventional and special mixing equipment. The process may start with latex blending and coprecipitation. As previously stated, in addition to the selection of the proper grades of resin and rubber, control of mixing (temperatures, cycles and method of addition) is very important to achieve the maximum properties of the blends. Impact, for example, can be drastically affected by mixing, and years of factory experimentation were required to achieve the quality of molding powder now sold.

The blends are processed into numerous products by calendering, molding, and extrusion. The fact that these blends do not have a sharp or critical softening point in many applications is a distinct advantage. For example, in the processing of large diameter pipe it is much easier to control dimensions and the cooling and sizing equipment can be simplified.

Applications for the blends or the "plastalloys," as they are frequently called, include golf club heads, molded helmets, carrying cases, molded cams, gears, pipe fittings, chair parts, door knobs, shower and spray nozzles, floats, valve parts, machine housings, and small machinery parts replacing metals, molded caps, bobbins, spools, quills, automotive applications, duct work, and foamed parts.

In summation, thermoplastics obtained from styrene-acrylonitrile resin and butadiene-acrylonitrile blends have high impact strength combined with good hardness and rigidity. The discussion has been limited to a single system which gives a high order of toughness and includes a compound with excellent low temperature properties, but the same principles should apply to other resin-rubber systems. Both suppliers and molders are evidencing growing interest in such combinations, which promises that future developments in rigid thermoplastics will include wider use of resin-rubber blends.

Blends of Phenolic Resins with Rubber

R. C. Bascom

B. F. Goodrich Chemical Co.

My assignment today is blends of phenolic resins with rubbers and in this short introduction I propose to discuss the characteristics, preparation, methods of processing and applications of such blends in a very general way. In the question and the answer period which follows more discussion will be given to specific problems.

Phenolic resins are the products of a condensation reaction between aldehydes, usually formaldehyde, and phenols. Phenols commonly used are normal phenol, cresol and specially modified phenols. When a phenol and an aldehyde are reacted together, and the reaction is permitted to go to completion, a hard strong resinous material is produced. If, however, the reaction is stopped short of completion, the resinous product may be of any desired

molecular weight and physical state. The product may be a liquid or a solid, but is usually thermoplastic. The reaction may be stopped by interrupting its course or it may be stopped by using a lower amount of formaldehyde than would be required to complete the reaction to a hard resinous product.

The product of this second type of reaction is the common type of phenolic resin used in the industry. In order to use this particular product it is necessary to add an activator, usually in the form of hexamethylene tetramine, which reacts with the partially converted resinous material to form a complex mass polymer with a great deal of strength.

Fillers and lubricants are usually added at the same time that the "hexa" is added to this resin. This is done by dry blending the powdered resin with the other ingredients, followed by a hot milling operation which serves two purposes: One, the resin is fluxed to form a continuous phase of resin around the filler particles; and, two, the resin-"hexa" reaction is started and the resin is advanced towards its final cure.

I have gone into detail on this operation because although it is well known, many people tend to forget that the resin reaction is irreversible and progressive. That is, each time the resin is heated it advances towards its final cure. Compounders who are used to processing rubber are sometimes surprised by the scorchy nature of phenolic blends.

Because molded parts made with the phenolic resin are inherently brittle and yet very strong, consumers and manufacturers of phenolic resins and manufacturers of rubber parts have been trying to make combinations of rubbers and phenolic resins for a long time. Phenolic resins and most rubbers are inherently not compatible. However, the advent of nitrile rubbers which are inherently compatible made practical, useful blends of rubbers and resins.

Most phenolic resins have a degree of compatability with all nitrile type rubbers. This compatibility is especially evident in the uncured state and such blends made on a rubber mill show a nice uniform smooth rolling bank and a translucent sheet. However, this very wide range of compatability seems to be limited to the uncured state and there is considerable interference with the cure or condensation reaction of the phenolic resin. Accordingly, the most useful cured blends of phenolic resins and nitrile rubbers are made with highly modified resins which are available from nearly all of the major phenolic resin manufacturers and nitrile rubbers with acrylonitrile content on the order of 40%. With these limitations, useful blends of nitrile rubbers and phenolic resins can be made over the whole range. Relatively small amounts of phenolic resin will reinforce the rubber to give a tough cured sheet without supplementary filler or vulcanizing agents, while a small amount of rubber will reduce the brittleness of the phenolic resin and produces a product which is quite tough.

The physical properties of such blends are nearly as one would expect. The rubber increases elongation and impact strength of the phenolic resins while it lowers hardness and tensile strength. The resin, on the other hand, increases the tensile strength and hardness and in general reinforces the rubber. Although special resins and rubbers are required to get a wide range of compatability, certain applications can tolerate blends with less compatability. For instance, a highly modified resin will reinforce shoe soles when GR-S is used even though there is not good compatability in this particular case, and small amounts of nitrile rubbers can be used to modify even conventional phenolic resins.

A discussion of preparation and processing of these blends must be broken down into the type of end application or industry. When these blends are used as adhesives, they may be blended in aqueous media solvent solution or as adhesive film. For instance, the resorcinol formaldehyde latex type of adhesive for tire cord. Nitrile latex is very often blended with phenolic resins in dispersion to produce an adhesive useful for flocking cement, wood glues and for other high strength adhesive applications. In aqueous blends it is important that the phenolic resin be a dispersion rather than a solution because free alcohols or phenols usually present in the phenolic solution cause the nitrile latex to coagulate. Blends of nitrile latex and phenolic resin are sometimes incorporated in wet process addition in paper for lamination into sheet material.

Solvent solutions for use as adhesives are prepared by adding soluble phenolic resins to solutions of nitrile rubber compounds. Adhesive film for use in bonding automotive brake shoes to bands are prepared by calendering suitable dry, mixed blends of rubber and resin. The film has thermoplastic adhesive qualities and strong bonds are obtained by curing an assembly under pressure.

In the rubber industry when phenolic resins are used to reinforce nitrile rubbers, the resin is added as part of the filler in the conventional method of mixing for rubber products. The resin produces an uncured rubber compound which is rather difficult to manage. It is thermoplastic, very boardy and rather stiff; when it is hot it tends to stick and it tends to be rather scorchy.

When a small amount of nitrile rubber is used to modify a phenolic molding compound, the rubber is added in the conventional phenolic mixing cycle as a powder to the powdered resin and fillers. The resultant powder mix is then fluxed on a mill for a very short time and then granulated. Although these operations are performed on conventional machinery for each industry, problems are introduced which were at first very troublesome. The resulting uncured compound is considerably tougher and stronger than the conventional phenolic mix. The problem of granulation of this mix is considerably more difficult than the granulation of a conventional phenolic molding compound. The rubber modified phenolic resin molding compound usually cured a little slower than the conventional phenolic and in most cases has considerably more flow. However, because of the unusual characteristics of blends of phenolic resins and nitrile rubbers, difficulties in processing are overcome and such blends are in rather wide use.

Applications of these blends cover such a broad industrial scope that it is impossible to cover them all. Accordingly, I will only mention a very few. First is the use of phenolic resin to modify nitrile rubber in shoe holders for a sole cementing machine. This piece made from tire cord filled natural rubber compound will completely wear out after six weeks of use. The same piece made from a phenolic resin modified nitrile rubber will be in excellent condition and still serviceable after 1½ years of wear.

I had previously mentioned the use of a highly modified phenolic resin to supplement high styrene resins in reinforcement of shoe sole compounds. This resin is useful in such compounds because it produces a more rigid, less thermoplastic shoe sole which has excellent resistance to deformation at a slight sacrifice in flex life. Such a shoe sole modified with a combination of phenolic resin and high styrene resin is useful on inexpensive women's shoes

where inadequate filling is placed between the uppers and the mid sole. A normal high quality styrene resin reinforced shoe sole will tend to deform in operation and show ridges caused by poor shoe manufacture. The more rigid phenolic reinforced sole on the other hand will bridge over these ridges and retain a smooth surface.

Adhesives made from nitrile rubbers and phenolic resins are useful in a great many applications. They adhere well to almost all materials except polyethylene, butyl and natural rubber. They are used for such high strength applications as the adhesion of brake bands to brake shoes for automotive brakes and for the adhesion of shoe soles to uppers in the manufacture of shoes, and, of course, they have a whole wide range of applications in between these two extremes. Harder molded parts made usually in phenolic molding plants utilize relatively small amounts of nitrile rubber to produce products which are hard, yet tough; strong and yet not brittle. Parts made from these compounds are used for three major reasons: First, thin sheets of the material can be cured and parts can be punched from the sheets without fracture. Second, large and complicated inserts can be molded into a part without danger of cracking from thermal expansion or contraction. Third, high impact strength can be achieved using fillers which are normally considered to be of low impact strength in conventional compounds. Thus a wood flour or asbestos loaded nitrile rubber phenolic compound would have the impact strength of a flock or fabric filled material. This is a decided advantage since larger sized filling materials in phenolic molding compounds increase the cost and difficulty of molding by a great deal; further, cellulosic materials used as filling for phenolic compounds tend to have relatively poor water resistance and correspondingly poor electrical properties. The use of mineral filled nitrile rubber modified phenolic molding compounds, permits manufacture of parts which have exceptionally good electrical properties and physical properties.

In conclusion I would like to point out that these blends offer compounding tools to both the rubber compounder and to the phenolic resin compounder. They permit the use of phenolic resins in applications where conventional phenolic molding compounds could not be used, and thus expand the market for both the nitrile rubber and the phenolic resins. These blends were created because there was a definite need for compounds with the physical properties made possible by the blends and we are quite sure that future blends will be created as the necessity for them develops.

Blends of Polyvinyl Chloride with Rubbers

W. J. Smith

Firestone Tire and Rubber Co.

Polyvinyl chloride resins may be compounded and fluxed to yield end products ranging from hard, rigid, brittle items to soft, flexible tough ones. The great bulk of applications for these resins to date has required products with some degree of flexibility and toughness. While rubbers can be used in small amounts in rigid products, this discussion will deal primarily with the modification of polyvinyl chloride into more flexible items partially or wholly through the addition of elastomers.

The acrylonitrile-butadiene copolymers, or N-rubbers, are by far the most commonly used elastomers for plasticizing or softening of polyvinyl chloride polymers and copolymers. These N-rubbers can be prepared with varying amounts of acrylonitrile, with different Mooney viscosities, with different modifiers, and in varying physical form. All of these variations can have a large bearing on the ease of processing of the resin-rubber mixture and on the resultant physical properties.

Polyvinyl chloride may be plasticized exclusively with the nitrile rubber, or, as is more common, with a mixture of the N-rubber and liquid plasticizers. In general, N-rubbers with medium acrylonitrile content, in the range of 30 to 37%, are the most useful for plasticization of the vinyl chloride resins. Rubbers with both higher and lower acrylonitrile contents, however, are compatible with polyvinyl chloride resins and are used where they can contribute to specific end properties.

N-Rubber plasticized vinyl chloride resins are characterized by excellent retention of flexibility and impact resistance after prolonged or repeated contact with oils, greases and aliphatic hydro-carbons in general, or prolonged exposures to elevated temperatures. This quality of being able to retain flexibility and impact strength after exposure to conditions which cause normally plasticized vinyl chloride resins to become stiff and brittle makes these blends very useful in many troublesome applications.

Among the less desirable characteristics of vinyl chloride resin compositions plasticized with nitrile rubbers have been the relatively poor resistance to light aging, the low plasticizing efficiency of the N-rubber as compared with the efficiency of most liquid plasticizers, and the processing problems which have been encountered. Proper stabilization of the vinyl resin and the rubber will improve aging and reduce processing problems. Use of liquid plasticizer chosen for its effect on the rubber rather that the resin will aid processing of the mixture and will give added smoothness of surface to calendered or extruded products.

Tensile strength of N-rubber and vinyl chloride resin blends is usually lower than vinyl chloride resin plasticized

to equivalent hardness with liquid plasticizers such as D.O.P. In very flexible calendered sheets, or extruded sections, blocking becomes more of a problem with the N-rubber plasticized compositions than with the liquid plasticizer mixes. Both of these properties can be improved, and greater resiliency and abrasion resistance can be obtained by vulcanizing the vinyl resin-nitrile rubber blend. Mercaptobenzothiazole and benzothiazyl disulfide are satisfactory accelerators of vulcanization. Such cured stocks are no longer thermoplastic to the point of reworking, but they can be postformed into useful articles after heating. Blocking of mixtures containing high percentages of nitrile rubber may also be reduced by use of lubricants such as Acrawax C or paraffin wax.

The effect of some variations in preparation of the N-rubbers on physical properties of the polyvinyl chloride-N-rubber blends may be summarized in a very general way as follows:

1. As the acrylonitrile content is increased, grease and oil resistance is improved, tensile strength increases, processability is easier, product surface is smoother, low temperature impact is poorer, resilience decreases, and blocking is reduced.
2. As the Mooney viscosity is increased, processability is poorer, product surface has a rougher appearance, low temperature impact is better, and blocking is again reduced.

In addition to the nitrile rubbers, polyvinyl chloride resin compositions have also been modified with other rubbers such as GR-S, polyisobutylene, and substituted acrylonitrile-butadiene copolymers. Many interesting variations in toughness, hardness, impact resistance, abrasion and chemical resistance can be obtained by modification of polyvinyl chloride polymers and copolymers with these individual rubbers or with combinations thereof.

Polyvinyl chloride and rubber mixtures are generally prepared by one of the following methods:

1. In one method, a pre-blend of the vinyl chloride resin, stabilizer, lubricant, fillers, liquid plasticizers, and color is made and fluxed on a hot mill (270°F-350°F) or in a banbury mixer (280°F-340°F). The rubber is then added to the fluxed resin blend.
2. In a second method, the rubber is pre-masticated on a cold or hot mill, or in a banbury mixer before being added to the vinyl resin blend as above.
3. In a third method, the rubber is pre-masticated on a cold mill and the vinyl resin and other compounding ingredients are added to the rubber as a filler while milling. The batch is later fluxed on a hot mill or in a banbury.
4. In another method, the rubber is pre-masticated in the banbury mixer and the vinyl resin pre-blend or individual ingredients are added thereto. The whole batch is fluxed at temperatures of 270°F.-350°F.
5. In still another method, a powdered, or fine crumb, form of the rubber is preblended with the vinyl chloride resin and other compounding ingredients in a ribbon blender or other type premixer. The batch is subsequently fluxed on a hot mill or in a banbury mixer.
6. In the final method, a homogeneous mixture of the rubber and resin is prepared by cocoagulation or coprecipitation of blended latices or slurries of each. Other compounding ingredients are added to the resultant blend on either a hot or cold mill, or in a banbury mixer.

The method of preparation to be used depends on the rubber content of the final stock, the permissible mixing time, the ease of processing required, and the desired smoothness of surface of the finished product.

Where the rubber is only a minor portion of the total mix, the compound is usually mixed in the same fashion as an ordinary vinyl chloride resin stock, but pre-mastication of the rubber will result in easier processing and a smoother surfaced finished item.

Where the rubber accounts for a substantial part of the total mix, good processing and a smooth surfaced finished product are obtained to fluxing of the blend. This is most satisfactorily accomplished by the cocoagulation or coprecipitation method. Nerviness of N-rubbers, which is particularly noticeable in mill mixing, is thus largely eliminated.

Another method of improving processing and surface appearance of vinyl chloride resin and N-rubber products is to breakdown the rubber on a cold mill in conjunction with addition of approximately an equal amount of calcined clay. Still another method is the hot milling or banburying of the rubber to the point where its Mooney viscosity has reached the second minimum. This latter result can also be duplicated by special polymerization techniques through which the N-rubber is partially cross linked with divinyl benzene.

It is always necessary to flux the vinyl resin, at some point in the process, to obtain its maximum contribution to the properties of the mixture. This is done by raising the mix to a temperature of from 270°F. to 360°F., depending upon the type of vinyl chloride resin and the particular compound used.

Calendering of polyvinyl chloride rubber blends is carried out in essentially the same way as straight polyvinyl chloride-liquid plasticizer compositions. The success of the calendering operation and the appearance of the finished sheet or film depend very much on the processability of the rubber, particularly as the percentage of rubber in the mixture is increased. Choice of Mooney value, acrylonitrile content, and physical form should be such as to give minimum nerve and graininess under the conditions of processing required to obtain the desired physical properties.

Strength properties of vinyl chloride and N-rubber blends are primarily dependent on the degree of fusion of the vinyl chloride resin. Higher milling and calendering temperatures (up to 360°F.) will result in better tensile strength provided both the vinyl chloride resin and the N-rubber are adequately heat stabilized. Agerite Stalite, Deenax, and Ionol are useful stabilizers for retarding oxidation of the rubber during processing, while a variety of lead compounds, the barium, cadmium laurate-epoxy resin combinations, and some tin compounds will prevent heat decomposition of the vinyl.

Processors of films of .010" and thinner must take special precautions in calendering vinyl chloride N-rubber blends. At such small roll openings, and at the processing speeds usually used for thin films, the heat buildup in the calender banks is much greater in stocks with high rubber content than with liquid plasticized compositions of similar flexibility. Double, or even triple, the normal quantities of the most effective vinyl chloride resin heat stabilizers may be required. Added amounts of lubricant may also be required to obtain smooth and even release from the calender rolls, as well as to avoid blocking in the roll of finished film after storage. These problems are less troublesome with heavier gauge films and sheetings, and as the rubber content of the stock decreases.

Extruders of polyvinyl chloride resin and rubber blends have a choice of feeding a fluxed resin compound or a compounded rubber to the extruder. The type of premixing equipment available usually determines this choice, although it is desirable to provide as little heat history as possible for both resin and rubber prior to the extrusion. In either case, the extrusion temperatures must be such as to completely flux the vinyl chloride resin if optimum physical properties are desired. Temperatures of from 300° to 360°F. are usually adequate.

Polyvinyl chloride resin and N-rubber blends have also been made into very thin cast films which can be cured during the drying operation. Such films are very interesting as packaging materials, having excellent grease and oil resistance, good clarity, high tear and tensile strength, and, with suitable compounding, good resistance to moisture vapor transmission. Complete solubility of the rubber in the resin solvents is necessary for best results from such mixtures, as well as some of the other characteristics which are needed for an N-rubber that will calender well with vinyl chloride resin.

Polyvinyl chloride resin and N-rubber blends are used in the following applications:

1. Jacket insulation on coaxial cable over polyethylene primary insulation.
2. As primary insulation on low voltage appliance wires.
3. Upholstery sheeting.
4. Extruded shoe welting and shoe uppers.
5. Thermoplastic tubing for beverages, gasoline, oil, solvents, and industrial chemicals.
6. Hospital sheeting and industrial aprons.
7. Packaging films.
8. Camera case coverings, motorcycle seat covers, and binocular containers.
9. Cured compounds for printing roll covers, gaskets, valve disks, football and basketball covers.

Resin-Rubber Rigid Blends—A Summary

Anthony J. Urbanic

The General Tire and Rubber Co.

When small portions of a specified rubber are added to a resin, we obtain certain advantages as well as other changes that may be regarded as disadvantages. The usual, and of course, important advantage of adding a rubber to a resin as you all know now is an improvement in toughness — the impact strength is raised both at room temperature and below. The rubber increases the flexibility and elongation of the resin so that a sudden force on the plastic is more easily dissipated without fracture. Most often twenty or more parts of rubber must be added to a brittle resin to get the desired degree of useful toughness and the more rubber that is added the greater is the improvement. Other advantages which are minor, but important are the hot tear strength and the lowering of the processing temperature. The former is important in both extrusion and calendering. Much difficulty is experienced with synchronizing takeoff equipment with an extruder or calender with a poor hot tear strength material. The lowering of the processing temperature may be important if the resin tends to decompose or to depolymerize. Otherwise some porosity in the finished product may be had.

On the other hand, certain disadvantages result from the addition of the rubber portion. It is a give and take proposition. You just don't get anything for nothing. The heat distortion, hardness, and tensile strength are usually lowered, the amount increasing with an increase of rubber content. Likewise, the processing conditions are altered as the resulting blend has usually poorer flow properties than the resin itself. For instance, an injection pressure of 18,000 psi is needed for a rubber modified styrene blend on the market today, whereas 12,000 psi. would be satisfactory for the resin itself. These poorer flow properties usually lead to longer injection cycles or to slower extrusion speeds. The weathering properties of the blend are also usually inferior to that of the resin and great care should be exercised in testing this property, especially the correlation of crazing and impact strength with time of weathering. This especially so if an outdoor end use for the blend is contemplated. The staining brought about by the antioxidant present in the blend should also be checked. It may be said that an antioxidant which appears adequate for the rubber itself may not be satisfactory for the blend. This is so because higher processing temperatures are required for the latter.

Shrinkage of resin-rubber blends may also be different than for the resin itself, e.g., plain phenolic has a shrinkage of 0.008 inch/inch, whereas rubber phenolic blend has a shrinkage of 0.010 inch/inch. Thus, molds designed for the former, especially if close dimensional tolerances are wanted, cannot be used. Of course the solvent resistance of a resin is also altered by incorporation of a rubber. Some of the drawbacks of resin-rubber blends mentioned above have been corrected at least for certain blends. For instance, by replacing the usual commercial nitrile rubber with a high Mooney very tight gel type in a styrene-acrylonitrile blend, the flow properties can be improved. Instead of a rough sheet off the calender, a smooth one is obtained by the modification.

What do we know about the rubber portion that forms a satisfactory resin-rubber rigid blend—will any rubber do or is the composition important? Yes, the composition is important. We know that a certain amount of com-

patibility must exist between the two phases to get a satisfactory product. For instance GR-S has not been successfully combined with a standard type phenolic because of lack of compatability. Therefore nitrile rubbers are used with these standard phenolics because they are more compatible. On the other hand, a rubber that is too compatible may also be undesirable because of the marked effect on the heat distortion.

It may be honestly said that the art of resin-rubber blends is advancing more rapidly than the theory. For instance, even the necessity of the rubber portion in a blend has been questioned. Some results that have been reported lately seem to indicate that the toughness of a resin may also be improved by the addition of another resin. For instance polyamide and polyvinyl acetate resins have been successfully mixed with epoxy resins to decrease the brittleness of the latter so it is reported. Also a recent patent tells of the improvement of low temperature impact strength of polyvinyl chloride with the addition of a styrene vinyl cyanide copolymer. However it is the author's opinion that only a small improvement in toughness results on adding a resin as compared to the marked improvement in adding a rubber to a resin.

The author was asked to make a few comments on other resin-rubber blends not mentioned so far but which appear to have promising potential importance of which have been reported.

1. Epon-Thiokol Systems. All of us know the excellent adhesive property of epons for adhering either polyester laminates to themselves, metal to metal or other rigid materials to themselves. However these epons have been too brittle for adhering more flexible type of products. And the toughness of the epon bond has been improved by incorporation of a Thiokol rubber, specifically Thiokol LP-2. 25 parts of the latter toughens the adhesive considerably.
2. Isobutylene-styrene Copolymer Mixtures. These systems are analogous to the butadiene-styrene systems discussed by Messrs. Holt and Sell. The resins are high styrene low isobutylene copolymers and the rubbers high isobutylene low styrene copolymers. Because these systems are saturated they have better aging properties than their counterpart, the styrene-butadiene type.
3. Neoprene-New Styrene Blends. These blends give a tough, high heat distortion material which has a high impact resistance at as low as -20°C. These blends are not cured which of course is an advantage in the elimination of curing cycles and in the disposition of cured scrap.
4. Ethyl Cellulose-Rubber Blends. With natural rubber 10 parts of ethyl cellulose gives a softer composition at the milling temperature and gives an increased elongation at break.

With GR-S ten parts of ethyl cellulose gives better dimensional stability and increased resistance to flex cut growth.

The most important methods of preparing resin rubber rigid mixtures are as follows:

1. Banbury. The best method of mixing is in a Banbury especially if the resin tends to flow readily at the mixing temperature, e.g., phenolics.
2. Mill Mixing. This method is used but has certain limitations including cost.
3. Latex Mixing followed by coagulation or spray drying. This method, of course, insures that the two phases are intimately mixed.
4. Ribbon blending of Powdered Resin and Powdered Rubber. This method is limited now because of the problem of preparing suitable powdered rubbers economically. Also it would be desirable to get powdered rubbers that can be easily vulcanized.
5. Ribbon Blending of Powdered Resin and Liquid Rubber. This method is also limited because of the difficulty of preparing liquid rubbers economically.

Other methods may be mentioned such as the incorporation of rubber during polymerization or the incorporation of chopped rubber with the resin in the extruder.

In the past, the preparation of these blends has been done by their promoters, the raw material suppliers. However, as this field of resin-rubber rigid blends will expand, and it definitely will, the blending will be taken over by many of the fabricators themselves, especially the larger ones who will formulate their own blends in the same manner that they now formulate their own recipes. It is at this time when we shall see the greatest expansion of rubber-resin blends—a time when we shall see the further merging of rubber and plastic industries and a time when we shall see a further impact of this great combine on the automotive, appliance, machinery, and other industries.

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Dear Friends:

The 11th annual Technical conference is history and we were glad to greet so many of you there. The Philadelphia Section is to be complimented of the fine job they did on this conference. Hard work and good planning were evident from the registration to the final gun. Anyone who failed to get something valuable from this conference must have closed both eyes and both ears. The attendance at the various sessions was good and of course, I was particularly interested in the number who listened to my paper on "Engineering of Mold Design." It isn't easy to condense 17 years of experience into a 30 minute talk.

I appreciated the new idea of having an invocation by a minister at the beginning of each session and believe this is the first conference to have this feature.

Yours for better living with Plastics,

Wayne I. Pribble

Wayne I. Pribble

SAMPLING INSPECTION

Dorian Shainin

Rath and Strong, Industrial Consultants
Boston, Massachusetts

One hundred per cent inspection is not reliable. How then can a molder take a sample of items and be assured that he tells accurately how a process is being controlled and what percent of the lot is defective?

This article is the sixth in a series written for the plastics molder by the Statistical Quality Control Committee of SPE, under the chairmanship of L. M. Debing.

A CRUSH STRENGTH OF not less than 250 pounds is specified for a radio cabinet. The inspection department has to decide the disposition of 2500 cabinets submitted as a lot.

That department's responsibility can be stated as to confirm or to deny that the required quality (a crush strength of at least 250 pounds) has been built in to that lot. If an inspection shows conformance, the lot is accepted. But if checking denies that the quality requirement has been met, some other disposition of the lot must be undertaken.

While a check of every cabinet (100 per cent inspection) has to be ruled out for destructive testing, it is of course possible for many other requirements of the product. Aside from considerations of economy, such a complete inspection is often a very poor way of finding out if the parts all meet specifications.

Try this simple test of the adequacy of 100 per cent inspection on a group of your inspectors. Print, in large letters, this sentence on a poster or on a blackboard,

FEDERAL FUSES ARE THE RESULT
OF YEARS OF SCIENTIFIC STUDY
COMBINED WITH THE EXPERIENCE
OF YEARS.

Ask each inspector to consider the letter F as a defective part, and to count the number of F's in that sentence. Each then writes the number on slip of paper.

A large company located in the Midwest tried this test on over 200 inspectors. Only 16 per cent got the correct answer, six. This result is unbelievable to most people. Only 80 letters make us this sentence but oversights certainly prevail for even such a small lot of product. The human mind is far from being as good as the human mind would like to believe. So one turns to sampling inspection because 100 per cent checking is:

1) unreliable
2) uneconomical
3) impossible for destructive testing.

Many people sincerely feel that checking a sample from a lot is also an unreliable way for determining the disposition of the lot. They are correct if the items are not homogeneously distributed within the lot. But if the weak cabinets, those of medium strength, and the higher strength ones are uniformly located in the lot (as would be the case if they had been thoroughly mixed), then the sample can be expected to contain the same proportion of different strength units as exist in the lot.

Getting a truly representative sample becomes the secret of successful sampling inspection. Another important principle makes sampling inspection extremely economical: there is no fixed relationship which has to be maintained between the lot size and the sample size. As long as the lot is homogeneous, the same size sample can be representative of the distribution of values (dimensions, strengths, visual defects, etc.) within a small lot or within a large lot.

PUTTING A LOT INTO A HOMOGENEOUS CONDITION

The thorough mixing of the items in a lot required for successful sampling could be accomplished if three things were possible:

1) the entire lot could be placed into one tumbling barrel
2) tumbling for many hours would not damage the parts
3) the parts are uniform in size and weight so that certain ones would not tend to be physically segregated according to these characteristics, such as settling out at the bottom of the mixed lot.

Perhaps a more convenient plan would be to assign a number to each unit, from one on up through the lot size, and mix these numbers in a barrel (as one could with each number marked on uniform wooden chips or disks). Then draw out a sample of disks from the mixture, and select those items of product for test that correspond to the numbers drawn.

To save steps, the results of such sample drawings have been tabulated in the form of tables of random numbers. (1) The expressions, "take a random sample," or, "take a sample without regard to the quality differences among items of the lot" mean that tables of random numbers should be used to guarantee a selection equivalent to that from a homogeneous lot. Do not be misled, you cannot get a random sample by taking pieces "here and there" from a lot, or by "stirring" the lot first, or by assuming that handling between operations, packing, etc. has mixed the lot sufficiently. Your sample will be in serious danger of not being representative of the lot.

HOW REPRESENTATIVE IS A RANDOM SAMPLE?

If a sample of two items were taken from a lot, which was 5 per cent defective, the odds are rather high that the sample would be made up of two acceptable parts. In the case of random sampling, there is one chance in twenty

(there being 5 defectives per 100) that the first piece drawn will be a defective one (or similarly one in twenty that the second one will be defective). There is one chance in 400 (the product of 1/20 times 1/20) that both items will be defective. The chance of either the first or the second being defective (1/20 plus 1/20 equals 2/20 or .100) is added to 1/400 or .0025 to give .1025 as the probability of one or more defectives occurring in the sample of two. So there is a remainder of .8975 or 89.75 per cent of the time that the sample will not indicate any of the defectiveness of the lot. In fact a sample of two can only show zero, fifty, or one hundred per cent defective. For this example, the sample would certainly not be representative of a 5 per cent defective lot.

Now consider a very large sample taken at random from the same lot. This sample should almost all of the time contain close to 5 per cent of its items as defective ones.

Two points should now be clear. While the size of the lot is not generally involved, as explained earlier, the size of the sample does have a bearing on the reliability of the picture the sample presents of the lot condition. And chance or probability calculations show just how often a lot of given per cent defective will produce random samples which are some other per cent defective.

THE NUMERICAL RISKS OF SAMPLING

The entire group of probability computation results show the action of any sampling plan. In practice a sampling plan is designed as a "decision maker" for the inspector, i.e. take a random sample of **n** items from the lot; if **c** or fewer items are found defective accept the lot. Then the computation results are plotted as a graph or curve of the "Probability of Acceptance" against a scale of values of "Lot Per Cent Defective."

As an illustration of the calculation of an Operating Characteristic Curve, consider a situation simple enough to permit an easy following of the computations. Take a lot size of 5, a random sample of 2, and an acceptance number (that's the **c** mentioned just above) of zero. Figure 1 demonstrates the action of this sampling plan.

The lot of 5 pieces is represented by the 5 circles in a vertical column. The lot is shown five times, with defective pieces being the cross-hatched ones and the good parts being clear circles. So 5 clear ones are under "0" Lot Per Cent Defective, 2 cross-hatched circles out of 5 under 40 per cent, and so forth. Of the 5 pieces, the top one will always be number 1, the next to the top number 2, down to number 5 at the bottom of each of the five lots shown. In terms of these piece numbers, there are just ten possible samples of two each, which can be drawn. These samples are the pairs of numbers at the bottom of Figure 1.

The Probability of Acceptance point for "0" Lot Per Cent Defective is at 1.00 because no possible sample can show more than zero defective pieces. When the Acceptance Number is never exceeded the lot is accepted 100 per cent of the time.

When the lot is 20 percent defective (shown with piece number 1 as the only cross-hatched one), four of the ten possible samples are seen to have piece number 1 represented. So 40 per cent of the time, in the long run, the Acceptance Number of Zero will be exceeded. This means a 20 per cent defective lot will be accepted 60 per cent of the time. That furnishes another point on the curve.

Next look at the 40 per cent defective lot. Piece number 1 and 2 are defective. Either a 1 or a 2 are found in 7 of the 10 possible samples. So 30 per cent of the time

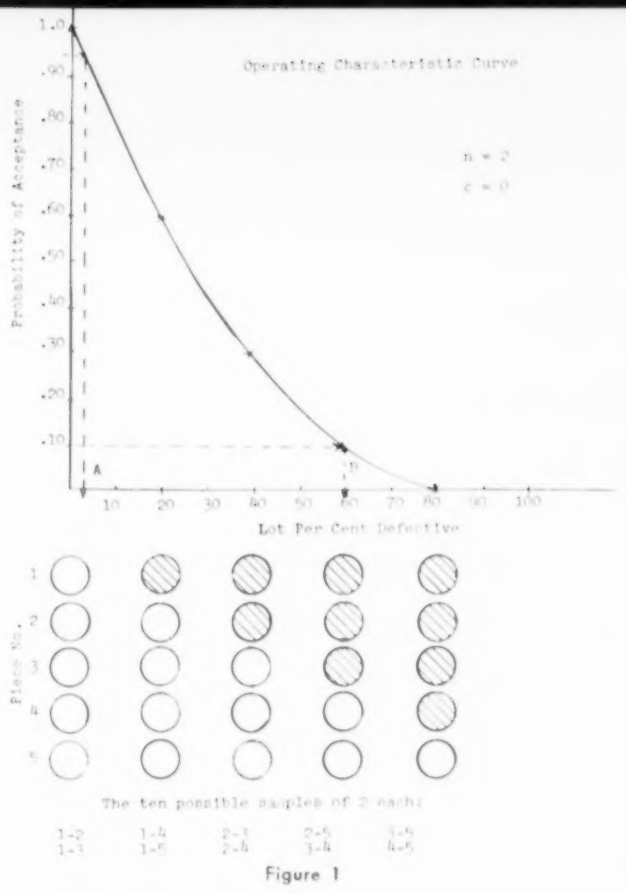

Figure 1

such a lot will be accepted.

An infinite number of different sampling plans can be designed, each with their own operating characteristic curve. Two portions of the curve give important information about the sampling plan; that for the upper end of the scale for Probability of Acceptance (corresponding to the lower values of Lot Per Cent Defective); and the right-hand, low end of the curve (at the higher values of lot defectiveness). The former is the region where lots are considered to be acceptable, and the latter the region of lots that should be rejected a high percentage of the time. In sampling plan design, increasing the Acceptance Number **c** keeps the curve up high as it moves to the right from "0" lot defectiveness, and so prolongs the drop-off until a higher lot defectiveness. This broadens the band within which material is considered acceptable. Increasing the sample size **n** steepens the slope of the drop-off portion of the curve, and so sharpens the plan's ability to discriminate between acceptable and non-acceptable material. A small sample size results in a flat slope, giving a large area of indefinite decision between acceptable and non-acceptable lots. In the illustration, with an **n** of 2, this area runs from about 10 to 50 per cent defective where the plan makes no consistent decision.

Conventionally two points are selected on the curve to describe, relatively, the acceptable region and the non-acceptable region. The first is taken at the .95 Probability of Acceptance, which is of course a 5 per cent probability of rejection—called the Producer's Risk. The other is at the .10 point—this 10 per cent probability of acceptance is called the Consumer's Risk.

The corresponding Lot Per Cent Defective points (A and B in Figure 1) are called the Acceptable Quality Level (AQL) and the Lot Tolerance Per Cent Defective (LTPD). If material happens to come to inspection exactly at the AQL value of defectiveness, the producer stands a 5 per cent chance of the rejection of such a lot (even though

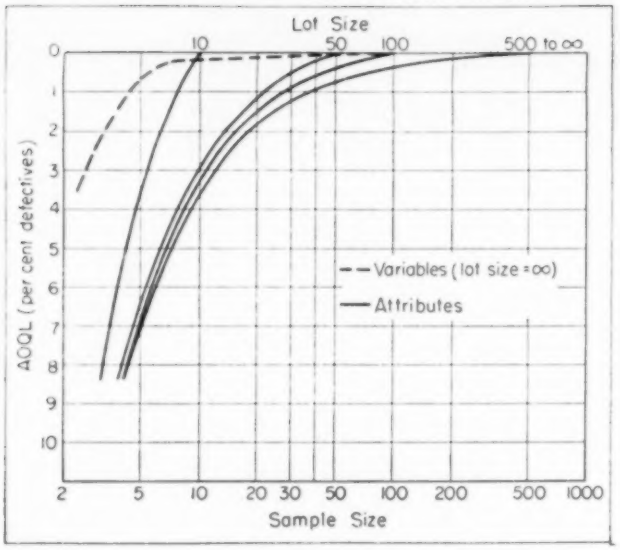

Figure 2

it really is in an area considered acceptable). If a lot happens to reach inspection at the LTPD value, the consumer will one time in ten find such material passed on to him as acceptable (even though it is in the rejectable region). Reference to Figure 1 will show a 4 per cent AQL and a 60 per cent LTPD.

THE LIMITING RISK CONCEPT

Assume a succession of lots of the same part each come to inspection 2 per cent defective. If the OC (Operating Characteristic) curve for the sampling plan being used by inspection passed through the 50 per cent Acceptance point at 2 per cent Lot Defective, half of the submitted lots would be expected to be accepted by the sampling.

So far this article has not taken up the matter of what is to be done to lots rejected by the sampling. A thorough screening of the remaining parts in the lot could be required, and this rule would make possible a limiting risk concept. The OC curve portrays the long run picture of acceptance probabilities without any limits. One cannot compute a satisfactory maximum per cent defective, which may reach the consumer. The curve shows that occasionally a "good" lot (low per cent defective) will be rejected and occasionally a "poor" lot will get by, and on out to the customer. In fact, if rejected lots are not screened, but simply returned to the supplier, he could resubmit such lots with the knowledge that if he did that enough times the OC curve shows that eventually the lot will pass sampling.

Now, say the screening rule is invoked. All lots rejected by sampling will have all defective pieces removed. In the example above, then, half of the 2 per cent defective lots would be made 0 per cent defective. If these cleared lots are now permitted to join and mix with the other half of the lots (the accepted ones which are still 2 per cent defective) and if all the lots are the same size, then the mixture is now 1 per cent defective.

Effective screening of rejected lots will bring about a reduction in the net per cent defective, thru admixture of them with lots accepted by sampling. To see this effect graphically, plot the products of the co-ordinates of points on the OC curve as points on a vertical scale of Average Outgoing Quality (AOQ) against the same horizontal scale as before, the Lot Per Cent Defective. This result will be a curve which peaks over. The height of the peak, read on the vertical AOQ scale, is the Average Outgoing Quality Limit (AOQL).

SOME PRACTICAL SAMPLING PLANS

Sufficient background material has now been covered to understand Figure 2. The plans discussed to this point, involving a count of the number of defective pieces if any found in the sample, are known as "Sampling by Attributes." The solid curves in the illustration show, for this type, how risk (expressed as AOQL) varies with sample size, and varies some with lot size. But this latter effect disappears when the lot size gets up to 500 or more. The Acceptance Number **c** for this chart is always zero, and the screening of all rejected lots is assumed to be completely effective in removing all defective pieces (also for the mathematics behind the curves, such removed pieces are assumed to have been replaced with good pieces—in practice this is generally not done and the effect is negligible.

If one keeps to the curve marked "500 to infinity," the sample size for any desired AOQL can be read.

The selection of a sampling plan for an inspection job in the plant has almost always been done poorly, the author has found. In the great majority of cases it has been due to too little knowledge about sampling, such as not knowing what AQL really means, or mixing up AQL and AOQL.

Some use sampling to "improve" outgoing quality. It is hoped readers of this series will know that there are much more effective SQC techniques for doing this, rather than by sampling and screening. A good rule to keep in mind here is: sampling becomes ineffective and uneconomical whenever the per cent defective coming to inspection exceeds either the AOQL or one-half the LTPD of the plan being used. You will be sorting so much material, and probably doing only a mediocre job of it because of oversights, that the best procedure is temporarily to forget sampling, concentrate on doing a slower, carefully organized 100 per cent initial check (followed by a sample check of the accepted material to see if the 100 per cent was effective), and most importantly institute the use of the appropriate SQC techniques for correcting the production process.

The two best-known published sources of sampling plans unfortunately have not in practice improved the brushing away of misconceptions about sampling inspection. They are "Sampling Inspection Tables — Single and Double Sampling" by Dodge and Romig, and "Sampling Procedures and Tables for Inspection by Attributes—MIL—STD—105A" a Government publication. Each covers a large range of risk, expressed as AOQL and as LTPD in the former, and as AQL in the latter. One gives Single (which have been discussed here) and Double (in some cases a second sample is taken before a decision is reached) Plans, while the Military Standard lists Single, Double, and Multiple Plans. Dodge and Romig introduce a process average concept to minimize total inspection between sampling and screening, and the other tables not only have arbitrary rules for switching from Normal to Tightened or to Reduced Inspection but also have three inspection levels to which the Government can switch according to rules not specified in the Standard. The author has seen all of this confuse plant people and Government inspectors. He contends good sampling practice need not be that involved.

Here are some suggestions with regard to the selection of practical attribute sampling plans. Keep in mind

(Please turn to page 37)

AROUND THE WORLD

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AUSTRALIA

AUSTRALIAN PLASTICS

Vol. 10, No. 106, May, 1954

Abstracter: **Albert Lightbody**

HOT GAS WELDING OF PLASTICS: F. L. Connors, p 6-15

Detailed instructions as to sizes of sheets and rods, heating methods, edge preparation and efficiency of joints made by the hot gas welding procedure are given with respect to their use on polyethylene, rigid polyvinyl chloride and polymethyl methacrylate.

PRACTICAL INDICES FOR CHEMICAL RESISTANT PLASTICS: Raymond B. Seymour, p 19, 20

A table giving relative values for plastics having value as industrial chemical resistant materials is shown whereby the properties as coat, specific gravity, structural strength, resistance to physical damage and resistance to temperature are given one rating and their resistance to attack by solvents, salts, acids, alkalis and oxidation another rating. The most perfect plastic material would receive a rating of 50 in each category. Typical examples are:

	Practical Index	Chem. Resist. Index
Reinforced Polyesters	38	31
Polytetrofluorethylene	24	50
Polystyrene	28	37
Polyethylene	30	42

AUSTRALIAN PLASTICS

Vol. 10, No. 108, July, 1954

HOT GAS WELDING OF PLASTICS: F. L. Connors, p 6-12

Continued from previous issue. This article deals with the welding of extruded tubes, both polyethylene and polyvinyl chloride. Charts giving recommended working pressures over a variety of temperatures and sizes provide an excellent basis for selection.

MEASUREMENT AND CONTROL OF TEMPERATURE IN THE PLASTICS INDUSTRIES: p 17-19

Discusses methods and instruments used in the plastics industry for temperature determinations and control, as well as speed indicators for extrusion and continuous thickness guages for film.

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CANADA

CANADIAN PLASTICS

September-October, 1954

Abstracter: **Harriman H. Dash**

PLASTICS IN THE FOUNDRY: Staff Report, pp 54-56

This report discusses the techniques employed in casting at the Shell Cast Alloys Ltd., Guelph. The shell molding techniques employed have eliminated the bulky sand molds formerly used and have cut costs as much as 50%, yet yielding castings with better tolerances and requiring considerably less machining. The shell process (also known as the Croning process uses a sand filled phenolic resin for producing the mold shell).

RADIOACTIVE TRACERS ANALYZE MOLD EROSION: p 57

GE has employed irradiated bushing to study the effect of molding compounds on erosion of molds. The method detects 1 part of metal in 20 million parts of plastic. By the use of this radioactive tracer method, GE has been able to institute a four-fold improvement in its thermosetting compound No. 12882.

CHEMICAL RESISTANCE OF POLYESTERS: J. R. Stevenson, (British Ind. Plastics Ltd.), p 64

The corrosion resistance of glass mat reinforced polyesters is presented in tabular form.

VACUUM METALLIZING TOYS: pp 66 and 118

Describes the use of the Stokes 72 inch metallizer by the Ideal Toy Corp. (New York). Injection molded scrap polystyrene items are vacuum metallized at ½ micron pressures. Total time for each cycle runs approximately 12-15 minutes. An under coat of lacquer prevents out-gassing; a top lacquer coat is applied for protection, and may be dipped dyed for different color effects.

NEW PLASTIC SPONGE: pp 68-69

A new company, the Collo Canadian Corp. has been set up to produce and market a new sponge known as polyurethane, and formed from isocyanate. Suggested applications include upholstery, orthopedic articles, padding, packaging, sound absorption, etc.

ELECTROFORMED MOLDS: (Paper read before the Annual Congress of the Swedish Federation, November, 1953.) pp 80-98

Electroformed hard nickel molds have been supplied by the London & Scandinavian Metallurgical Company since 1943. This method yields cheaper molds than the die sinking or hobbing procedures, and can also be employed for intricate shaped molds not producable by other methods. Master parts can be made in cast acrylic, phenolic, polyvinyl chloride (flexible materials are very satisfactory where undercuts are required), wax, wood, plaster, and even sometimes metals. The master is coated with a thin layer of conductive silver, then plated with a special nickel electrolyte (Swedish Patent No. 119,423) until the nickel (41-46 Rockwell C Hardness) is built up to a thickness of 5 mm. The nickel shell is backed with electroformed copper. Some of the technical problems associated with these processes are discussed in detail. The electroformed shells are bolstered with steel plates, the original silver removed chemically, and the cavity given a slight polish for a high mirror finish. Production time runs to about 3-5 weeks, but a considerable number of multiple cavities can be produced within this time. Runs of over a million moldings per cavity in thermoplastic materials have been reported for these molds. Thermosetting articles have shown runs to about 100,000, but higher runs are expected with the newer harder electroplated nickels. An extensive discussion of the application of this type of mold is also given.

ULTRASONICS FOR HOMOGENIZING AND BLENDING: F. Rose (Toronto), pp 100-101 and 118

Describes the use of ultrasonic waves (produced by mechanical fre-

quency generators) in the production of stable emulsions. Frequencies up to 22 Kc per second are used to produce particles as small as 1 micron (1/25,000 inch). Applications and advantages of this mixing method are discussed.

CANADIAN PLASTICS

December, 1954

POLYSTYRENE: pp 40-44

This is mainly a staff report of the Dow Sarnia Polystyrene plant. It traces historically the development and operations of the plant. The plant was set up in 1945. Polymerizations are conducted by passing styrene thru tubular heaters surrounded by dowtherm coolant. Close control of cooling and heating is maintained. Copolymers of the high impact type (styrene-butadiene) and low pressure laminating type (styrene-polyesters) are also produced in this plant. Dow also manufactures its own styrene monomer from ethylene and benzene starting materials. Monsanto also operates a polystyrene plant at Montreal.

VACUUM FORMING: G. W. Beatty pp 48-49

Vacuum formed parts are competitive with imported U.S. injection molded stock parts. Low capital equipment costs and possibilities for low production runs have aroused intense interest in this process. Most current work is in styrene sheet. It is estimated that such sheet consumption will triple in 1955.

SILICONES: USES AND INDUSTRIAL APPLICATIONS:
H. R. H. Miller, pp 51-54 and p 82

The first commercial production of silicones was initiated by Dow Corning at Midland, Mich. in 1943. It can be produced in various forms—liquids, gels, rubbers, soft and hard resins. The silicones are partly organic and partly inorganic, and thus combine the properties of both—flexibility, heat resistance, etc. They have excellent low and high temperature applications and are continuously finding increased uses in industry—release agents, oils and greases, adhesives, sizes, paper coatings, etc.

INJECTION MOLDING POLYSTYRENE: Jack Burnie, pp 60-70

This article presents a technical detailed discussion of the various factors governing mold design—effect of plastic flow, sprue and runner design, size and design of gates, automatic degating (3 plate mold), mold shrinkage, control of shot weight, mold temperatures, lubrication, and annealing. Machines up to 48 ounces are in current use in Canada. Higher capacity machines are not warranted due to the limited market, high mold costs, and the increasing competition from vacuum forming techniques.

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DENMARK

PLASTIC

Vol. 4, No. 7, July, 1954

Abstracter: Erik R. Nielsen

EXTRUSION OF SUPERPOLYAMIDES: J. F. Kohlwey

A discussion of superpolyamide extrusion, with emphasis on the special requirements for this type of plastic (feed, screw and die).

GUTTERS AND DOWNSPOUTS FROM RIGID POLYVINYL CHLORIDE: Reprint from Kunststoffe

Due to the shortage of zinc in East Germany, gutters and downspouts are being made of rigid polyvinyl chloride. The performance is good.

Vol. 4, No. 9, August, 1954

TRANSPARENT FLAT AND CORRUGATED PLASTICS AS BUILDING MATERIALS: Gunnar Lindedal

The uses of acrylic plates and corrugated glassreinforced polyesters for buildings is discussed, mainly on the basis of American practice.

POLYESTER - GLASSFIBER - LAMINATES: Johanne Moustgaard

This is the first of two articles to give a technical presentation of the chemistry, polymerization and fabrication of glassreinforced polyesters.

NEW MACHINES FOR SILK SCREEN PRINTING ON PLASTICS: Anon.

The French firm Dubuit makes machines for silk screen printing with a capacity of 2500 units/hr.

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FRANCE

INDUSTRIE DES PLASTIQUES MODERNES

Vol. 6, No. 9, November, 1954

Abstracter: Hans Mayer

In line of the stories **"The French Industry Gets Equipped"** P. Dubois describes the methods and the equipment of the new synthetic phenol plant of the Société Rhône-Poulenc.

The second installment of the story on **Printed Circuits** for the Electronic Industry discusses the use of printed circuits in different applications as in radio receiving sets, commutators, etc. and enumerates the plastic materials used as base materials as melamines, glass reinforced polyesters, silicones, glass reinforced Teflon and combinations of glass with Orlon or Dacron fibers.

G. Compagnon discusses **"Plexiglass in the Lighting Applications"** and describes a variation of lighting fixtures made from Plexiglass which are suitable for different applications.

TRANSPARENT MATERIALS FOR AVIATION: C. R. Riley

The fundamental problems of this application, methods of processing and a discussion and enumeration of the different types of plastic materials used.

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GERMANY

DER PLASTVERARBEITER

Vol. 5, No. 8, August, 1954

Abstracter: Ernest C. Bernhardt

PLASTICS CONFERENCE

Program of the 1954 German Plastics Conference held in Stuttgart.

COLORING OF THERMOPLASTICS IN THE INJECTION MOLDING CYLINDER: H. Spies

A special torpedo comprising a section with wide clearance and spiral flow path is described. It is designed to give the material a long flow passage with more than the usual amount of shear to aid in color mixing.

Vol. 5, No. 9, September, 1954

MOLDS AND EQUIPMENT FOR PROCESSING OF STYROPOR: F. Stastny

A very thorough and complete review is given covering the processing techniques recommended for Styropor. Styropor is a polystyrene resin containing a foaming agent. Applications illustrated included ribbons, pipe, insulating applications and packaging uses.

VACUUM METALIZING: H. Spahn

A comprehensive review including photographs of large scale German equipment used in vacuum metalizing of plastic materials.

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KUNSTSTOFFE

NOVEMBER, 1954

Abstracter: Anne Schwend

THE STATUS OF PLASTICS DEVELOPMENT: Rudolf Gath

This paper is an analysis of the overall technical and economical status of the plastics industry without considering details. Reviewing the problems with which the plastics industry was faced in the beginning which, in turn, impeded rush expansion of production and application, the author concludes that the development of plastics has to be considered as absolutely normal. According to the author, the second phase of development and adoption of plastic materials nears its end so that industry will soon enter the third phase which will be marked by a tremendous increase in demand. Superior processing

technique, well defined properties of specialized plastic materials and the knowledge about properties obtainable by combined use of metallic and plastic materials contribute to the success in filling this demand. In view of this tremendous upward trend the German plastics industry is faced with a number of big problems.

They include expansion of production facilities for base materials which, so far, hardly answered demand, training of young plastics engineers, technicians and chemists, intensification of efforts to have universities and technical high schools teach students more about high molecular chemistry and physics, continuous improvement of measuring and testing instruments and techniques for better control of production and processing methods. To solve these problems the German plastics industry is more than ever dependent upon help from outside to secure the required capital and thus help to make German plastic products competitive on the world market.

CREEP IN THERMOPLASTICS: S. Wintergerst and Eng. E. Rueckerl

The slow change in the structure of thermoplastics, called creep, is explained theoretically and the results of investigations communicated. Plexiglass specimen showed that as long as the strong secondary bonds in this material are not loosened by relatively high strains or the micro-Brown movement of molecules, elongation will always slow down steadily. However, as soon as such conditions no longer prevail, some bonds will tear apart at certain internal stresses. These ruptured bonds do not stay open, but the individual chain molecules attach themselves to other points. Creep continues at accelerated speed in these newly formed bonds. With the progressing orientation of the individual molecules in the direction of the tensile test the creep is retarded. Further loosening of internal bonds, however, will not permit the formation of new bonds. Hence, the presence of unsteadiness in creep appears to be dependent upon a certain degree in temperature and certain internal stresses. It is further apparent that there is a connection between the appearance of unsteady creep curves and the seeming viscosity as well as the initial speed of creep.

The external, visible creep marks are discussed and the following rule set up for the tests conducted: The higher the temperature and hence, the more elastic the test rod and the lower the elongation speed, the higher the degradation of the notch effect and thus the lower the tendency to craze. The appearance of cracks is hence bound to the prevailing of certain conditions as discussed.

APPLICATION OF NEW TYPES OF PVC FREE FROM EMULSIFIERS AND ELECTROLYTES: W. Klein

In Germany, PVC was heretofore produced mostly by emulsion polymerization. This process permits much greater production speed for rigid PVC—the emulsifier acting as lubricant in this case—than for polymerizers produced without emulsifiers. While, with this method, it has for a long time been possible to produce polymerizers of interesting molecule sizes, i.e., with K-values from 50 to 80, the polymerizers on the U.S. market, produced by suspension-polymerization, so far show K-values of only 70 to 80.

The Chemische Werke Huels A.G. has now succeeded in producing PVC by suspension-polymerization with the help of special activators, K-values obtained being 55, 60 and 65. This product, "Vestolit S55, S60 and S65", is available in beads of 150 μ and smaller and shows very good stability. The same plasticizers and lubricants may be used with suspension-polymerized PVC. However, organo-tin compounds will satisfy maximum demands while stearates will do in case of lower exigencies. Mixing of soft suspension-polymerized PVC is effected in plastics mills and the dry powder-process will yield completely dry purling powder. Granules obtained from the roll mill may be extruded in normal presses (screw length ten times the diameter) without any compression, while dry powdered PVC will require screw lengths of 15 to 20 times the diameter, thus guaranteeing a compression of at least 2:1. The most important field of application of soft PVC compounds is the coating of cables, requiring that only such stabilizers be used which do not impair the electrical values of the compound. Calendering of soft suspension-polymerized PVC yields films of high quality.

Plasticizer-free or rigid suspension-polymerized PVC shows higher mechanical values and better corrosion resistance than emulsion-polymerized PVC. Its electrical values are excellent; transparent parts can be molded. This type of compound may well be extruded or calendered, (films of up to 1.5 mm in thickness). Rigid Vestolit S65, for instance, has a tensile strength of 600 kg/sq.cm (8534 psi), elongation at break of 120%, impact strength test shows no breaking and is bigger than 250 kgcm/sq. cm (44.7 inch psi) and a notched impact strength of 11 kgcm/sq. cm (1.9 inch psi). Low water absorption and good resistance against diluted acids and lyes are remarkable features of this material and it may be added that plates from rigid suspension-polymerized PVC can well be exposed to a temperature of 160° C. (320° F.) for 30 minutes without appearance of bubbles. The blowing of rigid PVC films and the production of bottles are described. Injection molding not only requires the use of chrome-moly or chrome-nickel steel for those parts in touch with the molding compound, but also the use of a strainer in front of the injection nozzle to augment the molding temperature from approximately 180° to approximately 230° C. by friction. Injection pressure should be more than 1500 kg/sq.cm (21,335 psi). Finally, the subject of transfer molding of larger parts is briefly touched.

TRACK RESISTANCE — A CRITICAL CONTRIBUTION TO EXPERIMENTAL TECHNIQUE: H. Suhr

Numerous tests were conducted to obtain the data for a comparison of the different testing methods proposed for standardization of the track resistance of molding compounds (drop method, immersion and vapor methods), which showed that in general all three methods yield similar results. Further, as a chart demonstrates, all insulating materials with the exception of track-resistant lacquers either fell off after a few drops of immersions or held out more than 100 individual tests. However, there are some molding compounds which would have to be considered track-resistant according to one method and not track-resistant according to the other. Causes therefor are to be sought in the different circumstances to which the specimen are exposed. While the immersion test switches off the current during immersion of the specimen, the drop method does not shut off the current which practically results in a triple exposure time to current. The difference of temperature of the surfaces of the specimen is of influence, too (with the drop method a rise to 50° C. was observed while with the immersion test temperatures remained below 30° C. due to intermediate cooling off). Both the higher temperature and the longer exposure time to current will lead to a different classification of insulating materials. The author comes to the conclusion that the conditions imposed by the drop method are too severe and that the vapor or immersion testing methods more likely correspond to the formation of condensed water on a dusty insulator part in practice. Therefore, according to the drop method a certain material may not be used while, actually, there would be no danger of creeping current damages.

The appearance of flashover tracks may be avoided by proper designing. The distance between poles and the length of tracks may be so extended by building in separation walls and ribs that creeping current can no longer do any damage.

Comparative tests with the ASTM Method D 495-48 T showed good con-

Kunststoffe—cont'd.

formity with the results obtained by the proposed German methods.

Additional investigations undertaken with direct current resulted in a different classification of insulating materials. Electrolytical processes intensified the formation of cavities and the wolfram electrodes were severely attacked so that they had to be replaced continuously.

GERMAN STANDARDS

Reprint of draft for DIN 7708, part 3, for aminoplasts, i.e. formaldehyde condensation thermosettings on the basis of urea, dicyan diamides, melamines or/and their derivatives.

INJECTION MOLDING OF HEAVY PARTS: Hans Volland

This article essentially relates information from U.S. sources on avoiding sink marks, bubbles and molded-in stresses in injection molded heavy section parts. Proper use of pin-point gating in connection with a collecting chamber built into the mold platen between nozzle and sprue so as to prevent direct touch of the warm nozzle and the cold mold platen and thus early solidification of the thermoplastic material, use of plasticizing cylinders offering low frictional resistance as well as weigh feeding will permit the molding of heavy section parts or parts with largely varying section diameters without great difficulties.

EXPERIENCE IN HF PREHEATING OF THERMOSETTING PARTS: W. Hasel

Comparative test molding of thermosetting compounds not preheated at all, or preheated in an oven or preheated by means of HF gives proof of the superiority of molded parts produced by the last method as far as quality of surfaces, internal homogeneity, mechanical and electrical properties are concerned. The advantages of HF preheating—saving of energy and piece production time—become the more evident the heavier the sections of the parts in question are. Practical advice as to choice of suitable HF preheaters, their use, maintenance, and supervision is given based on many years of experience.

NEW PVC FACTORY IN GERMANY

The Dynamit A.G. vorm. Alfred Nobel & Co. at Troisdorf near Cologne, has inaugurated a new plant for the polymerization of vinyl chloride which is produced at the Rheinfelden plant.

PRODUCTION OF PERLON IN GERMANY

Completely new production facilities were put to work at plant Dormagen of the Farbenfabriken Bayer for the production of acrylic fibres, endless Perlon and acetate silk. The new Dormagen acrylic fibre is practically identical to Orlon 42. Monthly capacity for these fibres is 45 tons.

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GREAT BRITAIN

PLASTICS

October, 1954

Abstracter: A. T. Rexer

PLASTICS WIDELY USED IN NEW COMMERCIAL VEHICLE: pp 320 and 321

This illustrated article describes the construction of a light three-wheeled van. The conditions of manufacture, namely low cost with small production, were successfully met with the use of a glass-fibre polyester resin structure.

PLASTICS IN THE SERVICE OF MAN: pp 322 thru 325

A pictorial review of high-quality units molded or otherwise fabricated in Great Britain for use in radio and television.

FARNBOROUGH 1954 SHOW REVIEWED: pp 326 thru 331

A well-illustrated article gives the uses of many different types of plastics in the construction and fitting-out of aircraft. The following paragraph headings are included: Structural Materials, Acrylic Components, Jigs and Tools, Raw Materials, Cables and Other Electrical Applications, Interior Fittings, Packaging, and Finishes.

THE EFFECTS OF BIAXIAL STRAIN ON THE PROPERTIES OF ACRYLIC SHEET: by S. J. Barker and A. W. Birley, pp 344 thru 347

This article describes the work done to determine the effects of varying degrees of orientation of the molecules in acrylic sheets produced under the special conditions of biaxial stretching on the physical properties of the sheet. These effects are shown in chart and table form under the following headings: Tensile Properties, Dynamic Properties, Flexural Properties, Impact Strength, Stress-solvent Crazing, Thermal Properties, and Birefringence. References are also given.

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BRITISH PLASTICS

Vol. 27, No. 10, October, 1954

Abstracter: Evert A. J. Mol

PVC IN THE GARMENT TRADE: Anon., pp 376-380

Vinyl film is used for rainwear, aprons, shampoo capes, shower caps, bootees, baby pants, hanging fabrics, protective clothing. In the U. K. 120-150 tons of PVC film per week are produced of which 50% is used for rainwear, (equal to 1/3 mill. raincoats) and another 10 tons go into baby pants. Coated fabrics are becoming increasingly popular, especially the fleecy backed variety.

Good formulation is the key to good quality, in the formulations the plasticizer is an important component. Plasticizer blends are used to obtain the desired qualities as: good low temperature resistance, non-migratory properties, permanence, resistance to soap solutions, non-toxicity, grease-resistance, flexibility, tear strength.

REFLEX REFLECTORS: Anon., pp 382-386

Reflectors for automobiles and bicycles are of prismatic construction, the reflecting surfaces of the facets lying in three planes.

Two thermoplastics have succeeded the earlier glass: acrylics and polystyrene. Of the two, the acrylics are better resistant against automotive fuels and less prone to crazing, are however, more difficult to mold and more expensive. Also, its lower refractive index makes a considerable difference in reflective power at wider reflecting angles. The molds are built up from groups of hexagonal pencils. Each pencil has three accurately lapped facets, together these facets form the pyramidal reflecting surface of the molding. The molding operation itself requires special attention to details. Size of gates and runners are very important, runners of heavy cross section up to the gates are favored.

GLASS POLYESTER SPORTS CAR BODY: Anon., p 387

The 2 and 3-seater shells discussed are made of woven rovings, scrim cloth and Bakelite SR 17460 cold-curing polyester resin, mixed with fire retardants. Incorporated bulkheads add strength and rigidity. The moldings, made in female molds, weigh approximately 112 lbs., cost about 30 dollars and are used on a H.P. Ford chassis.

POLYETHYLENE BALL FLOATS: Anon., pp 392-393

4½" to 7" diameter ball floats, for use in cold water tanks and lavatory cisterns are injection molded in two non-symmetrical parts in an 8 oz. machine and subsequently welded together by the same operator at a rate of 40 floats per hour. The floats do not fail at test pressures of 135 lbs/in² which is three times the required pressure.

AIRBORNE EXTRUDER: Anon., pp 400-401

A description of this flying pipe extrusion plant has appeared in Modern Plastics, November 1954. It consists of one completely equipped Windsor type RC 100 extruder, installed in a tractor drawn trailer that can be flown to its destination in a Blackburn Beverley freighter. The main savings lie in the difference in transportation costs between equal weights of pipe and extrusion compounds.

(Please turn to page 54)

THE *Injection* MOLDERSCOPE

By A. R. Morse

President, Injection Molder's Supply Co.

"It is the freedom to disagree, to quarrel with authority, in intellectual matters to think otherwise, that has made this nation what it is today." Dr. James B. Conant

What is ahead for 1955 and the injection industry? In one man's opinion, here it is. The threat of vacuum forming, like low pressure laminating of two years ago, has been pretty well discounted. Neither low pressure molding, nor vacuum forming have developed into the clear cut threat to our industry that they at first appeared to be. They did not have the anticipated smooth sailing that could have made extremely precarious an investment in large injection machines. These potentially competing processes have many problems, fortunately for us, that have not yet been surmounted. If they had no scrap problem, if they had no finishing problem, if they had been able to use really cheap molds as originally hoped, our industry's picture would be a lot gloomier than it is. Take vacuum formed food boxes against injection molded ones, for example. The injection molded box is clear, tough, and substantial. In spite of these properties, the draped box still looks like a formidable competitor at first glance, and someday it may be. Right now, for it to compete, would require a tremendous investment in extruders, and entirely new, fully automatic machinery construction. To sum up: vacuum forming, drape molding, and low pressure laminating will have only a long term impact on us, as the processes are further refined and developed, and not the immediate impact some people at first thought, myself included. But do not let this slowing up of the expected impact make us complacent about the threat these processes pose—with enough expenditure of time and money, they could have given us a severe jolt—and they still may if development work should suddenly be accelerated by some really big scale investment—something that would parallel the GATX plunge into the injection field.

In 1955, I expect still further economic repercussions from the consumer reaction against injection molded housewares and toys that do not stand up in service. Some molders are already redesigning their molds, adding wall section instead of cutting it, slowing cycles instead of speeding them up, and generally trying to get their lines built back up, but it is going to be a slow process getting our foot back in many a disillusioned buyer's door. It takes real courage to buck the competitive trend, and those far-seeing molders who are taking corrective measures are to be congratulated.

In equipment you will see continued increase in emphasis on automatic molding, especially in presses of 4-6 oz. size. Greatly increased competition between press makers in the 12 oz. field has resulted in rapid press improvements in 1954. You will see the same competition in 1955 extended to the 20-28 oz. size, as several new models are appearing in this range. It is curious that the 8 has seemed to drop out of the picture after dominating it for years. Larger molds make the 12 oz. size much more economical than the old 8's and 9's. By the middle of 1955 virtually every injection press maker will be out with completely new redesigned presses.

In accessory equipment, considerable competition has developed—some of it almost unscrupulous in the way attempts have been to duplicate existing products. One concern actually used a photo of his competitor's machine, and another even lifted bodily extracts from existing literature. Such tactics are, I suppose, the equivalent of problems faced by the injection molder whose product is put on a Gorton by an imitator. We ourselves, try not to imitate, and we are taking the plunge with an entirely new idea in a big parts granulator—a 10"x17" throat, 10 horsepower, two stage grinder which shows real promise of having the highest capacity per horsepower of any grinder made; and also with a completely self-contained vacuum type barrel unloader and hopper loader, which we hope will overcome the numerous objections to present screw and compressed air type of loaders.

All in all, 1955 should parallel 1954 except for the greatly increased obsolescence factor in equipment caused by the doubled and trebled wattages of new machines, necessitating that many molders must soon make extensive capital outlays for new or modernized presses in order to remain competitive, or else find themselves hopelessly behind the times when 1956 rolls around.

Dr. Max Laeis Plastic Authority Visits America

Dr. Max E. Laeis, world renowned promoter of the utilization of injection molding machines, and of the entire plastics field, and author of the first German book on injection molding, is currently on a business visit to this country which, we trust, will give him opportunities for pleasure as well.

Dr. Laeis, who studied at the Universities of Munich, Frankfort, and Wuerzburg, and whose contributions to—and accomplishments in—the field of injection molding, date back more than a quarter century, will this month celebrate twenty-five years as president of Eckert and Ziegler, famous manufacturers of injection molding machines, of Weissenburg, Bavaria, Germany. He also heads a large German plant producing injection molded products. His activities in the past 25 years have been directed towards the distribution of injection molding processes all over the world.

Also very well known in America, Dr. Laeis brought the first injection molding machines to the Celluloid Corporation of Newark, the Columbia Protektosite Company, Foster-Grant, and other firms in this country in 1930. Since then, the Doctor has greatly widened the scope of his activities and associations here, with the result that today he is known and respected as a leading authority in his field.

Dr. Laeis' first book, a volume on injection molding, was published in Germany in 1940. His latest, titled "Injection Molding of Thermoplastic Materials", is nearing completion and is scheduled to be published early this year. It, too, promises to be a widely consulted instructional and reference book and will probably be translated from the German.

We know we express the sentiments of the entire S.P.E. membership when we say, "Welcome, Dr. Laeis. It is an honor to have you among us."

SECTION NEWS

Edited by

Stanley Bindman

Jamison Plastic Corp.
1255 Newbridge Road
North Bellmore, L. I., N. Y.

New York

New Officers Are Introduced At Annual Christmas Party

Arthur M. Merrill

The New York Section celebrated another year of expansion and progress at its annual Christmas party on December 15 at the Gotham Hotel. The gala affair included a cocktail hour, dinner, and an elaborate entertainment program, all of which were greatly enjoyed by the record attendance of 150 members and guests. As in the past, arrangements for the party were handled by Saul Blitz, Tico Plastics, Inc.

Harold H. Schwartz, Empire Brushes, Inc., and 1954 Section chairman, presided over a brief business session following the dinner, and introduced the new officers and directors for 1955. The new officers are: president, G. Palmer Humphrey, R.C. Molding, Inc.; vice-president, Arthur S. Jacobs, Augusta Plastics, Inc.; secretary-treasurer, Guy A. Martinelli, Sylvan Plastics, Inc.; and national director, Stanley Bindman, Jamison Plastics Corp.

The Section directors are as follows: (three-year terms) George W. Leaf, Leaf Plastics, Inc.; Herbert J. Weber, Rotuba Extruders, Inc.; and Alan K. Zimmerman, Monsanto Chemical Co.; (two-year terms) Foster Monaco, Mastercraft Plastics Co.; Irvin I. Rubin, Robinson Plastics Corp.; and Mr. Martinelli; and (one-year terms) Arthur L. GeWertz, manufacturers representative, and Messrs. Humphrey, Jacobs, and Schwartz.

Mr. Schwartz thanked the outgoing officers, directors, and committee chairmen for their work last year. Mr. Humphrey also expressed his appreciation, and presented a gift to Mr. Schwartz on behalf of the members in token of their esteem for his services.

Table favors were distributed to everyone attending through the courtesy of Armaplast Corp., Archer Plastics Co., Arrow Plastics Corp., Empire Plastics Corp., Ideal Toy Corp., Leaf Plastics, Inc., Moonglow Novelty Co., Robinson Plastics Corp., Rosenberg Bros., and Waljohn Plastics, Inc. The party concluded with a drawing for some 30 door prizes contributed by the following companies: Archer Plastics Corp., Celanese Corp. of America, Empire Brushes, Inc., Ideal Plastics Corp., Monsanto Chemical Co., H. Muehlstein & Co., R. C. Molding, Inc., Sylvan Plastics, Inc., Tico Plastics, Inc., Valentine Dolls, Inc., Waljohn Plastics, Inc., and Wess Plastic Molds, Inc.

Six new members were added by the New York Section during the past month, as follows: H. R. Burgess, sales engineer, H. H. Robertson Co.; James T. Dugan, assistant editor, "Plastics Technology"; William E. Kelly, special representative, Goodyear Tire & Rubber Co.; Herbert M. Mass, sales representative, H. Muehlstein & Co.; Horace J. Ried, salesman, Electro Technical Products Division of Sun Chemical Corp.; and Arthur R. Rubin, sales representative, Rubber Corp. of America.

Reinforced Plastics Group Meeting

The regular dinner meeting of the Reinforced Plastics Group of the New York Section took place on December 1 at McGinnis' Restaurant. Approximately 45 members and guests attended the meeting which featured two talks: "A Survey of Standards in the Plastics Industry," by Gordon M. Kline, National Bureau of Standards; and "Micro-Balloons," by R. P. Courtney, Bakelite Co.

Dr. Kline discussed the need for standards in the plastics industry, and the work being done in this direction by the various technical societies, federal government agencies, and industry trade oranizations. Mr. Courtney gave a brief talk on Micro-Balloons, which are hollow beads of phenolic resin for use in the manufacture of core materials.

N.W. Pennsylvania

Section Sponsors Christmas Dance, Dinner Meeting

Edward A. Zacks

On November 23rd, the Northwestern Pennsylvania Chapter of the SPE held a regular monthly meeting at the Village Hotel with about 60 members in attendance. This was a dinner meeting followed by introductions of the new officers and directors and a floor show.

The new officers elected by the board are president, Pack Bricker, Erie Engine Co.; vice-president, Edward Hilleman, Sylvania Electric, Warren, Pa.; secretary-treasurer, Aaron Wagner, Quinn-Berry Corporation. There were also three new board members elected for a three-year term —James Murphy, Aaron Wagner, and Edward Hilleman.

It was announced by the new president that the types of meetings were going to be changed to incorporate both a social meeting in the respect of a dinner meeting with some type of entertainment as well as stressing the value of education by having a speaker or discussion for the group.

The annual Christmas dinner dance of the Northwestern Pennsylvania Chapter of the SPE was a tremendous success, it being held on December 15th at the Kahkwa Club at Erie, Pa. This function is always well attended every year and is enjoyed by the members as well as their wives. This year's affair was arranged by Jim Quinn, general chairman, Jack Bricker, Don Leet, and Fred Kraft with the very able assistance of Mrs. Don Leet. Mrs. Leet took into her hands the buying of all the door prizes for the ladies. According to the remarks of the winners, of which there must have been at least twenty, she did an excellent job. Besides this, each lady attending received a corsage through the compliments of the chapter. Everybody received a cigarette case (plastic, of course) made by the Byrd Plastics Co. of Erie.

All in all, everybody had a very fine time which in the eyes of the Chapter marks the end of another good year of the SPE in Erie.

The purchase of the plastics division of Nubone Inc. by Perry Plastics Inc. has been announced by Mr. J. C. Stokes, Perry president. The facilities obtained in this purchase have not been moved to a consolidated location as yet, due to the lack of space to do so at this time. Mr. S. C. ("Sid") Seley, formerly president of Nubone Inc., has now assumed the sales management of Perry Plastics Inc. as a full time occupation.

(Please see top next page)

N. W. PENNA. (Continued)

Nosco Plastics Inc. has recently added a four place airplane to its facilities. Mr. Harry H. Kugel, president, states that this is part of the expansion program which included the purchase of a larger plant not long ago, the plane program having been under consideration for some time to meet the needs of keeping pace with the lively plastics industry. We believe that this brings to four the number of Erie area plastics molders utilizing private airplanes to improve service.

Mr. John P. Brecker has just joined Erie Engine and Mfg. Co. as sales engineer; this well established company has gained considerable prominence the last several years, having introduced a line of presses for compression and Fiberglas reinforced plastics molding. Jack Brecker is well known from his previous association with Louis Marx Co. and Nubone Inc. and is president elect of the Northwestern Pennsylvania Section of SPE.

Necrology

Raymond J. Wingerter

A few weeks ago the death of Raymond J. Wingerter occurred suddenly. Ray Wingerter had been sales manager of Nosco Plastics for several years and had been an important factor in the progressive growth of that company. He was well known in the plastics industry and his many friends were shocked to receive this news.

Southern Cal.

Elect New Officers; Name Committees

Felix C. Karas

Southern California Section officers are: president, Walter H. Kadlec, E. I. duPont de Nemours & Co., Inc.; vice-president, Paul A. Erskine, Hess, Goldsmith & Co., Inc.; secretary, A. Allen Ray, Ray Products Company, Inc.; treasurer, Harold F. Dague, Collins, Caldwell & Dague; national director, Austin H. Herbst, Irvington Varnish & Insulator Co.; section directors, Roland D. Griffith, Harold F. Dague, Joseph B. Potoczky, Paul A. Erskine, Walter H. Kadlec, Don A. Hamilton, William E. Braham, and A. Allen Ray.

Committee Chairman are: membership, Roland D. Griffith, Resin Industries; credentials, Roland D. Griffith, Resin Industries; program and reservations, William J. Dewar, Standard Plastics; publicity and SPE Journal reporter, Felix C. Karas, 1047 Kagawa, Pacific Palisades, Cal.

Regular meetings are held on the first Tuesday of the month at Scully's Restaurant, 4801 Crenshaw Blvd., Los Angeles 43, California.

NORTHWESTERN PENNSYLVANIA OFFICERS

Old and new offices of the Northwestern Pennsylvania Section are shown at the December dinner meeting. They are (l. to r.) out-going President Donald Leet—Buffalo Molded Plastic Corp.; out-going Vice President James P. Quinn—Quinn Berry Corp.; incoming Secretary-Treasurer Aaron P. Wagner—Quinn Berry Corp.; incoming President Jack Bricker—Erie Engine Corp.; Publicity Chairman Edward A. Zacks—Erie Plastics Co.

Ontario

Young Speaks To Canadians On 'Plastics In Appliance Industry'

On November 16th the Ontario Section of SPE held its regular monthly meeting. Mr. C. B. Young, manager of the Appliance Engineering Section of Canadian Westinghouse Co. was our speaker, speaking on Plastics in the Appliance Industry."

Mr. Young stated that the growth of the appliance industry very closely parallels that of the plastics industry. The first application of plastics to appliances was on the hand-iron back in 1905. The use of plastics by this industry has grown rapidly ever since, most major appliances having been introduced by 1920.

Each year plastics have been incorporated into their designs more and more, with refrigerators using in some cases up to 20 lbs. of plastic materials per unit.

Mr. Young feels that they are over most of their early mistakes in using plastic materials, using plastics with greater care and proper design. The attitude that the appliance industry now takes is "Lets Investigate Plastics."

The growth of the use of plastics can be split into two stages. The first phase was its use in functional parts such as fuse blocks, terminal boards, etc. In the second phase plastics became an important part of appearance and styling. Plastics offered a greater diversification in styling and allowed model changes with minimum expense by the use of decorative inserts.

Reinforced plastics, he feels, holds the most promising future for them. They are looking into this phase of the industry and plan on looking at it for some time to come.

The big problem they have is insufficient volume to support large tooling expenditures. As an example 488,000 refrigerators were sold in Canada in 1953, 220,000 of which were imported.

In the discussion period that followed it was suggested that vacuum formed parts might be part of the answer to small quantity production problems in Canada.

Mr. Young's reply to the question of how much scientific study went into the selection of parts was that they rely more on information supplied by the supplier than anything else.

Maidment Promoted To Vice President

Islyn Thomas, president of Thomas Manufacturing Corp., Newark, New Jersey, a leading producer of plastic toys and other products, has announced the recent promotion of former toy sales manager Bert W. Maidment to vice president in charge of company sales.

In making this announcement, Mr. Thomas, a world-renowned plastics engineer, designer, author and lecturer, also declared that the remarkable advances of the company in its comparatively short existence are due in great degree to the conscientious efforts of carefully selected capable executive personnel as exemplified by Mr. Maidment.

Plastics Engineering Degree Course Initiated By Lowell Technological Institute

Russel W. Ehlers

The year 1954 marked another milestone in the progress of Lowell Technological Institute with the pioneering of a four-year undergraduate curriculum in Plastics Engineering. This came as no abrupt decision.

For years the Lowell, Massachusetts area had been faced with an unemployment problem brought about by a dwindling textile industry. Then the community discovered the key to survival in diversification and, with general cooperation, encouraged new industries to locate in Lowell.

Meanwhile, the plastics industry was experiencing a phenomenal period of growth. Well-trained plastics engineers were at a premium. Here the Institute found opportunity to perform an invaluable service for the fast-growing industry and for the community, at the same time.

Thus, with the approval of the L.T.I. Board of Trustees and the Commonwealth of Massachusetts, the plastics program at L.T.I. was initiated last September under the able guidance of President Martin J. Lydon, Dean Charles F. Edlund, and an Advisory Committee made up of the following industry representatives:

Dr. Samuel L. Brous, General Electric Company; Dr. C. Kilbourne Bump, Monsanto Chemical Company; John M. DeBell, DeBell & Richardson, Inc.; C. P. MacIver, Victory Plastics Co.; George W. Whitehead, Improved Machinery Inc.; George W. Wright, Dewey and Almy Chemical Company.

Dr. Russel W. Ehlers was appointed as head of the new department of Plastics Engineering at Lowell Tech. Since receiving his Ph.D. degree in Chemistry at Yale in 1932, he had been employed in plastics research and development for industry and the government. His work included the use and application of natural and synthetic resins in the textile, automotive, and ceramic industries.

Under Dr. Ehlers' leadership, the plastics program at Lowell Tech will train students specifically to cope with the many technical and production problems of the industry. Greater emphasis will be placed on the study of enginering principles involved in the fabrication of plastics materials than on the extensive treatment of the chemistry and theory of high polymers.

The fascination which plastics holds for the career-seeking student is evinced by the fact that already thirty-three students have indicated Plastics Engineering as their choice. This means that facilities and personnel must be ready within the next few years to accommodate an estimated enrollment of more than 100 students in the plastics curriculum.

Dr. Russel W. Ehlers

Current periodicals and the latest books dealing with plastics and related subjects are being added to the shelves of the L.T.I. Library. A budget of $45,000 has been approved for the purchase of equipment for the 1954 school year, the first increment of a total of about $200,000 requested for a five-year period.

This equipment, which includes modern processing and testing machinery, will occupy for the next few years several thousand square feet of floor space in the present buildings. Five years from now it will be housed in a projected new engineering building—a completely self-contained plastics laboratory.

Within the next few years, equipment will be purchased to provide facilities for the preparation of test specimens; the production, processing, and fabrication of plastics materials; and for the testing of both plastic materials and end products. Facilities for test specimen preparation will include a lathe, milling machine, drill press, molding press and mold for test specimens (both for compression and injection molding).

The processing laboratory will be equipped with a small pilot plant resin kettle (with pressure and vacuum devices) for the synthesis of typical resins; resin mixers; compounding and calendering mills; presses for compression, injection, transfer, extrusion, low presure molding; jigs, fixtures and molds for vacuum forming, blow molding, casting, plastisol molding and fabrication.

Testing laboratory equipment will be machinery necessary to determine the mechanical, electrical, physical, and chemical properties of the principal types of plastics as influenced by composition, structure, and method of manufacture. Environmental conditioning will be provided by facilities for controlling temperature and humidity, and low and high temperature cabinets.

Eqiupment will be provided to evaluate such properties as strength, plasticity, impact and wear resistance, hardness, ageing, moisture absorption, dimensional stability, permeability, and various electrical properties such as resistivity, loss factor, arc resistance, and dielectric constants.

The published thought and advice of renowned educators in the plastics engineering field have provided a sound foundation on which to build a curriculum. The cooperation of L.T.I.'s Departments of Engineering, General Studies, and Chemistry in offering new courses and modifying existing ones has been invaluable in establishing a curriculum embodying to a great degree most of the recommended requirements for a sound program.

For example, Elementary Physics will include discussions of elastic and dielectric properties extended to the high polymer field. Organic Chemistry will introduce the role of polymerization in the production of noncrystalline organic materials. Engineering Drawing will include problems based on various types of molds and layouts used in the plastics industry.

In Machine Tool Laboratory plastics will be used to study various machine operations such as dulling, cutting, milling, and turning; in addition, a number of the simpler molds will be fabricated. In Mechanics and Strength of Materials plastics offers a group of new materials to illustrate the general basic properties of matter for which metal and wood are usually used. In addition, such properties as relaxation, creep, crazing, and similar properties vital in the selection of the proper plastic material will be studied. Fluid Mechanics will be designed to instruct the student in the theory and operation of the various hydraulic systems encountered in plastics manufacturing. Industrial Instrumentation will acquaint the student with the modes, methods of measurement, and control of process variables using mechanical, electric and electronic instruments commonly encountered in the plastics industry.

The entire curriculum is designed to provide the plastics major with a broad training program rather than with one of narrow academic specialization, as it is recognized that a well-rounded scientific and engineering background is the prime requisite for a succesful career in plastics.

In regard to courses relating directly to plastics and other high polymers, the Chemistry of High Polymers includes a theoretical study of

the physical and organic chemistry and plastics; the mechanism and procedures for polymerization, copolymerization and condensation; structure and size of polymer molecules and properties of solutions of polymers. Laboratory experiments give the student the opportunity to apply the theory.

Technology of Plastics, in the L.T.I. curriculum, comprises a comprehensive study of the basic properties, application, processing, and fabrication of high polymers as engineering materials. Topics studied cover the manufacture and compounding of plastics; important engineering properties as influenced by composition as well as processing and fabrication and their measurement by various test methods, including ASTM standards; methods of processing and molding such as compression, injection, transfer, extrusion, vacuum forming, blow molding, laminating cold molding, casting, plastisol molding, fabricating-cementing; heat sealing, welding, machining and finishing; mold and product design primarily concerned with the application of materials particularly in reference to the design of molding and fabricating equipment and the design of the plastic parts.

Laboratory instruction includes the practice and interpretation of the measurement of physical and chemical properties of plastics materials and molded parts, compounding, molding, laminating, and finishing. The student is taught operating techniques of processing and testing machinery used in the plastics industry from the pilot plant resin kettle through the final evolution stage. Included are the study of environmental conditions combined with the effects of various types of loading on such mechanical properties as strength, elasticity, and plasticity as well as on the electrical, thermal, and optical characteristics.

At the beginning of the third year of study the training of one plastics engineer may deviate from that of his fellow student. It is generally accepted that studies in the humanities and social sciences form an important part of the program to broaden the student's outlook and develop his ability to present clearly and effectively the results of his scientific investigations. Therefore, at the start of his junior year, he must make a decision and choose one of four groups of electives, or optional cores, for study in areas of finance, management, sales, or, if desired, in the humanities. Thus, the student receives effective guidance in selecting a correlated sequence of elective courses in a particular area. As an illustration, the following subjects are offered in the Management Core: Accounting, Industrial Management, Personnel Management, Modern Labor Problems, Business English, and Speech.

Approximately twenty per cent and thirty-five per cent of the credit hours in the junior and senior years, respectively, are for electives. As previously pointed out, the majority of these are in the General Studies area. Additional electives in Engineering and Chemistry are listed for the student to select to complete his quota. Typical of subjects in this group are Mechanism, Advanced Statistical Methods, Statistical Quality Control, Differential Equations, Theory of Atomic and Molecular Structure, and Advanced Organic Chemistry (Theory and Reaction). German is recommended to those students planning to continue in Graduate Study.

An analysis of the credit hours distributed among the various departments of study reveals the following percentages:

Basic Science, 25%; Chemistry, 25%; General Studies, 20%; Engineering, 15%; Plastics, 15%. The statistics on General Studies does not include compulsory AF ROTC for the first and second years.

From these data it is evident that the training program outlined will prepare the graduate for development, plastics production and sales gather than for positions devoted primarily to fundamental research. He will have at his command sufficient technical skill and know-how to convert process high polymeric materials into useful end products. Further, his broad background will permit him to fit into the specialized training programs sponsored by many of the leading plastics companies. He will be prepared to pursue a professional career or establish his own business. If he desires, and circumstances allow, he will be qualified to take advantage of more advanced study at the graduate level.

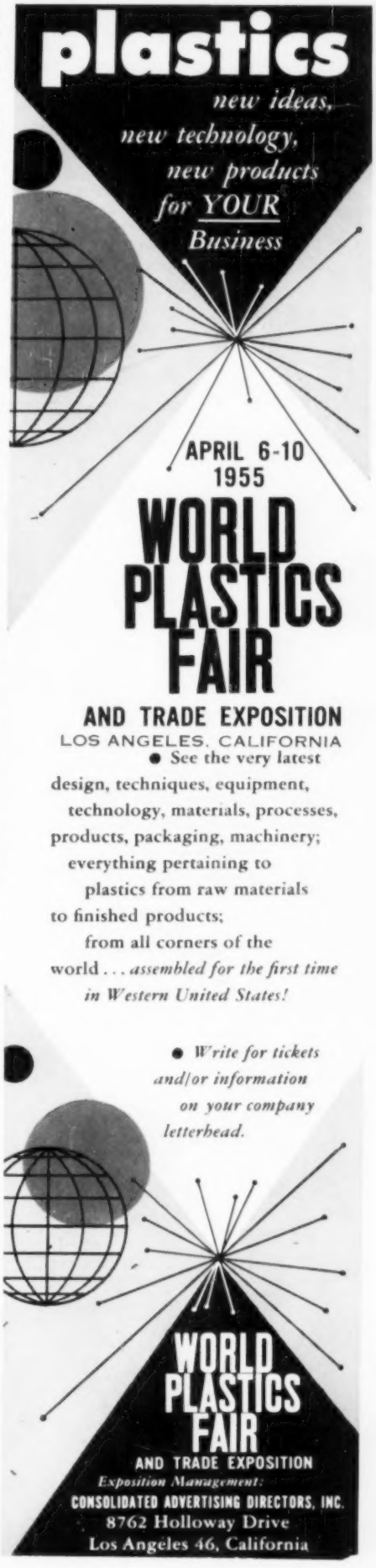
The successful execution of a progressive program is based on cooperation between education and industry. Lowell Technological Institute plans to serve industry by augmenting the supply of well-trained plastics engineers to meet industry's increasing demands. In return, there are a number of ways in which industry can encourage the development of the educational program. Some of these are:

1. By providing a reliable flow of information regarding the number and types of plastics engineers required each year;

2. By participating in the establishment of fellowships and scholarships as an incentive for the superior student to choose a career in plastics;

3. By providing industrial orientation for the student and the teacher through vacation and spare-time employment;

4. By augmenting and improving the educational facilities through the loan of processing and testing equipment.



Southern

New Officers Are Announced

C. Veazey LeCraw

The membership of the Southern Section and their ladies enjoyed a fine variety program on December 13, 1954. Excellent entertainment in the form of close harmony was furnished by the Peachtree Pipers, nationally ranked barbershop quartet. John farmer, known around Atlanta disc jockey circles as "The Farmer's Boy John," did an excellent job MC-ing the special occasion. The section plans to turn this special "Ladies Night" program into an annual affair.

Announcement of the new officers and the new members of the Board of Directors highlighted the meeting. Officers for the coming year are as follows: President, Leo J. Diamond, Koppers Co.; Vice President, C. E. Ballentine, Scripto, Inc.; Secretary, Bradford L. Nicholson, Manufacturers' Agent; Treasurer, C. Veazey LeCraw, Lockheed Aircraft Corp.

The three new board members elected for three years are C. E. Ballentine, Bradford L. Nicholson, and Robert D. Jones, The Glidden Co. The six remaining board members are as follows: for two years—Raymond W. Kruse, Rohm & Haas; Harold J. Torgesen, Gladwin Plastics Co.; and C. Veazey LeCraw; for one year—Jules W. Lindau, III, Southern Plastics Co.; Richard Linneman, Gladwin Plastics Co.; and Leo J. Diamond.

The Southern Section owes a lot to its outgoing officers under whose leadership the Section ended a very successful first year with 60 members on the roll. Especially is the Section indebted to Ray Kruse, the outgoing president, for it was through his initiative and efforts that the first group of interested people met in Atlanta and discussed the forming of a section of SPE in this area.

PLASTICS AROUND THE WORLD

(continued from page 30)

ISOCYANATE ELASTOMERS: E. G. Curphey, pp 407-409

Polyesters can be reacted with isocyanates through urethane and carbamide links to produce high molecular weight materials having rubberlike properties and being both highly abrasion resistant and oil resistant.

The chemistry of the reactions involved is discussed together with the influence of composition, hydroxyl- and acid-numbers and reaction conditions (acid versus alkaline). As an example of the influence of the diol used in the preparation of the polyester, the tensile strength, tear strength and shore hardness are given of products prepared with butane diol, mutyne diol, trimethylene glycol and, ¼-cyclohexane diol. Besides the isocyanates, diamines are utilized as interlinking agents; castable and uncastable compositions can be made, depending on the reactivity of the components used. Aliphatic isocyanates react more slowly than aromatic isocyanates; in contrast, aliphatic bases show more reactivity than the corresponding aromatic bases.

AN ANALYTICAL STUDY OF THE SINGLE SCREW EXTRUDER: Part I: Charles Maillefer, pp 394-397

This is the first part of a condensation of C. Maillefer's thesis at the University of Lausanne, entitled :Étude théorigue et expérimentale syr le fonctionnement des boudineuses (1952).

The study on the flow of melts does not contain any new information, the same results have been obtained by H. S. Rowell and D. Finlayson, Z. Rogowsky, W. T. Pigott, M. J. Boussinesq, W. L. Gore, J. M. McKelvey, J. F. Carley, R. S. Mallouk, E. A. J. Mol, W. Meskat and others.

The discussion of the flow of dry powders is interesting but does not recognize the fact that a feed channel in an extruder screw is in reality a deep helical channel so that torques rather than forces should be balanced. Furthermore, we do not agree with the author's statement that for forward movement, $\mu' \sin \phi \; 6 \; k\mu'$, we think that forward movement stops when $\phi = 90° - \alpha$ e; in that case cotan $\alpha = \tan\phi = 0$ and the through put Q must also be zero.

BRITISH PLASTICS

Vol. 27, No. 11, November, 1954

CURRENT USES OF GLASS REINFORCED PLASTICS IN TRANSPORT: Anon., pp 425-428

Discussion of exhibits at the Commetcoal Transport and Motor Shows held in London. Examples include: complete body of a 5-cwt. delivery van and of the Jensen 541 sports saloon, a semi-tramparent roof on a "pantechnicon", cab roof and rear wings, various parts of a double decker bus, hard tops for Singer four seater roadster and for two seater sports models produced by Austin Healey and Triumph, dinghies, prams, a 20 ft. molded cabin cruiser.

HAM CRACKING IN VINYL RAINWEAR: A. D. Clarke, pp 444

It has been found that a small percentage (under 1%) of vinyl raincoats develop small vertical cracks in the lower hem, especially at the back. An investigation has shown that this type of cracking can be attributed to the action of high speed flexing and is due to the application of very high local stresses (as in the flapping in the wind) at a point source, the "point" developing at the seam because of the mechanical stiffening effect which this has on the garment when flexed.

A practical solution for this problem was to reinforce the seam with a "piping cord", catgut or nylon monofilament. The local mechanical stiffening resulting causes the hem to bend in a small curve and not at a point. Stresses are so distributed more evenly and hem cracking is eliminated.

SOME TRENDS IN THE CONTINENTAL USE OF PLASTICS: Anon., pp 414-419

This amply illustrated article is mainly a discussion of things seen at the 4th International Technical Exhibition at Turin in Sept., Oct. of this year.

Shown are amongst other things: polyethylene reversible siphons for wine and liquor bottles, polyethylene-vinyl siphons for chemical fluids, street car seats from decorative laminates, polyethylene flowers, rigid vinyl gutters and piping, glass fiber reinforced polyester binsmski sticks and automobile hoods, nylon motor housings and even a nylon motor boat propeller, melamine table ware.

VACUUM FORMING AND DRAPE MOLDING: P. A. Sauter, pp 420-42

Drape molding is a form of vacuum forming where the heat softened sheet is not drawn into a negative mold but unto a positive mold. The method is of particular value for articles with a high depth to diameter ratio where the thermoplastic sheet does not have sufficient elongation to be drawn into deep negative molds.

Furthermore, corners and edges are stronger in drape molding and there is less distortion which is very important in the fabrication of pre-printed tri-dimensional maps.

The Formvac 2G5 (or 2G3) is described as a machine that can perform both positive and negative molding. It has an effective molding area of 42x60" and a 14" depth of draw. Heating is done by an infra-red heater at a surface temperature of 1475° F.

A special problem, the stripping of the molding from the mold on which it sticks due to contraction, is solved by careful timing of the blow-off air application and cooling cycles.

AN ANALYTICAL STUDY OF THE SINGLE SCREW EXTRUDER. Part II: Charles Maillefer, pp 437-440

Part II presents the experimental evidence for the theoretical work of part I. This kind of evidence has been given by others in earlier publications and offers no new facts. No experimental data at all are presented on the most interesting subject, that of the flow of dry powders.

Golden Gate

Movie Tour Is December Feature

Judging from the many comments, the annual Christmas Party of the Golden Gate Section was quite a success.

The affair was held at the New Rex Restaurant. After a good dinner a scenic movie was shown, a tour through the canyons and national parks of the West via Union Pacific R. R.

There were special place favors for the ladies and others for all and many fine presents. A short talk by our vice president, Leonard Faber, concluded a jolly evening.

Plastics Course Established At Newark College

Milton A. Sanders

Newark College of Engineering's special courses division announced today that enrollment in its new series of plastics courses has been so great that the two sections originally scheduled have been expanded to six, and three additional instructors have been added.

The two courses, one on Injection Moldings and the other on Compression Moldings, show a registration of 90 executives and workers in the plastics industry from 29 companies in the northern New Jersey metropolitan area.

Besides the two instructors originally appointed, Milton A. Sanders of the Sun Tube Corp. and John Lombardi of the Shaw Insulator Co., the college has obtained the services of William O'Hagen, product engineer with the Park Plastics Co. of Linden, N. J.; Allen Serle, product engineer with Sun Tube; and Albert J. Monack, instructor in Physics at the college.

The courses, which began January 4, will be expanded into a three-year certificate program beginning next September, with the addition of eight more courses to bring a complete survey of modern techniques and methods to workers in the industry.

St. Louis

Color Movie Shown At Christmas Meeting

R. S. McDorman

The St. Louis Section of The Society of Plastics Engineers held their annual Christmas party at the Melbourne Hotel on December 14.

The chapter had a wonderful evening of entertainment. A color movie called "Chuchako" was shown which showed a 200 mile trip through Alaskan wilderness and Glaciers. This picture was taken from a boat powered by a Mercury outboard motor.

Mr. Al Werner gave a talk illustrated by color slides on his trip around the world which he made last summer. He educated the audience as to the price of Canadian Club in various parts of the world.

The directors of the chapter were announced. They are: Carl Tabor, President; George Prall, Vice President; obert McDorman, Treasurer; and William Stephens, Secretary.

Presents were then distributed.

Industry Notes

Canadian Resins

Appointment of Kenneth B. Mathewson to the newly-created position of assistant to the vice-president, Canadian Resins and Chemicals Limited, is announced by R. J. Southwell, vice-president. At the same time, the appointment is announced of George M. Hale as manager of the industrial products division. He was formerly assistant manager and succeeds Mr. Mathewson.

Deroit Plastics Products

Detroit Plastic Products Co., Mount Clemens, Michigan and Cincinnati, Ohio is tripling their plant capacity.

Mr. E. E. Erickson, President and General Manager, made this announcement today. "We are now building an ultra-modern injection molding plant, which will triple our present capacity. In our new building, we will enjoy the finest equipment on the market today, and we'll be in a position to help satisfy this increased demand for our quality products."

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Non Section
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News of the Industry . . .

Special Fluoro-Polymer Available from D and R

Polyfluoron from Acme Resin Corporation, Forest Park, Illinois, is a new improved member of that family of fluorocarbon polymers which have distinguished themselves in special applications because of their unique high-temperature and chemical-resistant properties. It is a high molecular weight thermoplastic polymer of chlorotrifluoroethylene.

The value of this new plastic material for special end use such as in electronic wire insulation for high-temperature operation, radio tube sockets, printed circuits, valve seats, diaphragms, and gaskets has been explored experimentally and proved successful. A unique dispersion system for electrical and corrosion barrier coating applications has generated widespread interest in the chemical processing, electric power, electronic, packaging, and radio and television industries.

POLYFLUORON is to be sold and serviced in the East by D & R Pilot Plants, Inc., or Hazardville, Connecticut. Write Dept. SPE for more information.

At present the price per pound for POLYFLUORON is high for a commercially available plastic—ranging from $8.50 for low-density polymer to $10.50 per pound for Dispersion in ton quantities.

Printed Circuit Booklet

Advantages of printed circuitry for electrical and electronic systems are covered thoroughly in a new 12-page bulletin just published by the National Vulcanized Fibre Company, Wilmington, Delaware.

Titled "Mechanize Your Wiring . . . With Copper-Clad Phenolite," the bulletin highlights the numerous potentials printed circuitry offers design engineers and manufacturers. Of particular interest is a discussion of the economies of printed circuit design and construction as compared with conventional handwriting methods.

The fully-illustrated bulletin comprehensively covers basic technical facts and design data related to applied printed circuitry. Methods of producing printed circuits and design and construction considerations are treated in detail. Also presented are complete specifications on, and properties of, Copper-Clad Phenolite, a National product which is the most widely used base material for printed circuits.

Copies of the bulletin may be obtained from Dept. SPE, National Vulcanized Fibre Company, Wilmington 99, Delaware.

Rotational Casting Machine

The Akron Presform Mold Company of Cuyahoga Falls, Ohio, has developed a new high production rotational casting machine for producing hollow molded plastic articles.

Mr. T. A. Miller, president of the company, describes the rotational casting machine as consisting of a turret base with a series of six arms or spindles which support the multiple cavity molds. These molds are rotated through the gelling and fusing phase of the electric oven. They then pass through the cooling chamber which is the final stage of producing a resilient form. Each of these spindles is individually controlled through a series of electric micro-switches and timers. Write Dept. SPE, at the address above.

Sampling Inspection . . .

(Continued from page 24)

that it is rather unusual for a production group to produce just small or very moderate amounts of product beyond limit. Much more often it either all comes within limits, or an unexpected trouble puts a larger than "very moderate" amount of product beyond limits.

If your product is such that it is uneconomical to screen rejected lots, consider this plan for dimensional characteristics, which have to assemble with mating dimensions (the author has found from experience that 4 per cent defective is about as far as one can go without encountering occasional assembly difficulties):

n	c	AQL	LTPD
50	0	.25%	4%

The OC curve corresponding to this plan says that lots coming to inspection more than 4 per cent defective in such a characteristic will have less than one chance in ten of passing. Critics of this selection will say the AQL of this plan is too tight. However, the small likelihood that production can turn out very many lots running around 25 to 50% defective permits the practical use of this plan. This is fortunate because here is what would be involved to liberalize the AQL:

n	c	AQL	LTPD
225	5	1%	4%

And when it is found that quite a few inspectors cannot find all 6 defectives in a sample of 80 letters (the sentence test), one may wonder about the success of this change in plan.

Still keeping to product uneconomical or impossible to screen, if the characteristic being sampled functions independently (it is a strength requirement, for example) then a plan like this one may be needed to keep you out of trouble:

n	c	AQL	LTPD
225	0	.035%	1%

For reasons just given the large sample size is not attractive. If attribute checking has to be done, then a special study of inspection methods, lighting, fatigue-relief steps should be made to minimize oversights. Also use a periodic check sample, by another inspector, of the **accepted** samples (if the check has not been destructive), say, an n of 50 and a **c** of 0 plan. If the inspection has been destructive, or at any rate it is possible to get readings from the checks, an inspection by variables can better be employed. Figure 2 shows, in the broken curve, how much more effective such plans are than attribute methods, thus allowing the use of much smaller sample sizes. Space will not permit a description of these variables plans, but references are given at the end of the article.(2)

If screening is possible, the limiting feature of AOQL suggests these plans:

	n	c	AOQL
mating	9	0	4%
independent	38	0	1%

Remember here that a mixture of lots with and without screening must be possible. A good rule is that the turnover must be slow enough for each part number so that by the time the end of one lot is being drawn from the storeroom at least ten succeeding lots are already in the room. In many plants this has not been the case and incoming lots had to be subdivided (the above sample being taken from each sublot) in order to obtain the required mixture over a "long enough run."

(Please turn to page 38)

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One of the nation's largest executive agencies presents an exclusive service for men in the plastics and allied industries. This is a confidential, professional and rapid service for the nationwide placement of successful men under 45 in the engineering, technical, sales and administrative fields. Send a short resume including age, education and work history and we will tell you by return mail what we have available for you and how we can help. Write to H. Graebner at Graebner's Executive Exchange, 116 South Michigan, Suite 705, Chicago 3, Illinois. We also offer a special service to companies seeking qualified applicants in any field. Write for more information.

CHIEF ENGINEER—wanted for large well-established INJECTION MOLDING Company that also does painting and assembly located on Long Island, New York. Full responsibility for all engineering, including product development, mold design, tool and product estimating, ordering and follow up of molds, development and installation of manufacturing methods. Experience in high production paint spraying helpful. Salary open. Confidential. Reply immediately, Box 655, SPE Journal, 34 E. Putnam Avenue, Greenwich, Connecticut.

PRODUCTION SUPERINTENDENT

Nationally known eastern plastics material supplier has opening for production superintendent. Prefer background in thermosetting field. Must be experienced in labor relations and have necessary background to correlate and supervise plant's entire production. Work in conjunction with management, sales and planning section. This represents an unusual opportunity for the right man. Salary commensurate with experience. Please send complete work resume and photograph with first letter to Box No. 555, SPE Journal, 34 E. Putnam Avenue, Greenwich, Connecticut.

Sampling Inspection . . .

(Continued from page 37)

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EXACT INJECTION MOLD TEMPERATURE CONTROL
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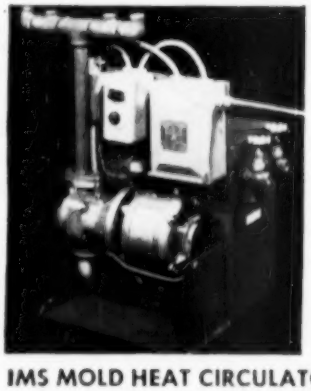

QUICK POSITIVE HEAT

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ONLY 18" x 18" FLOOR SPACE

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COMPARE RESULTS

IMS MOLD HEAT CIRCULATOR
Price Complete . . . $349.50

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Performs The Same Job
As Big Costly Units
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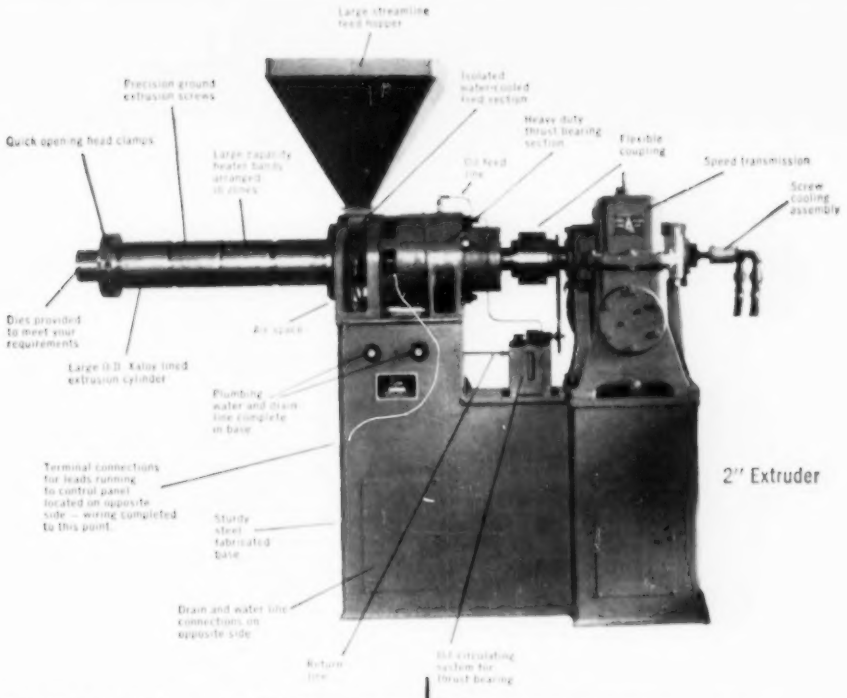
Egan plastic extruder


Large streamline feed hopper
Precision ground extrusion screws
Isolated water-cooled feed section
Quick opening head clamps
Heavy duty thrust bearing section
Flexible coupling
Speed transmission
Screw cooling assembly
Large capacity heater bands arranged in zones
Oil feed line
Dies provided to meet your requirements
Air space
Large I.D. Xaloy lined extrusion cylinder
Plumbing — water and drain line complete in base
Terminal connections for leads running to control panel located on opposite side — wiring completed to this point.
Sturdy steel fabricated base
Drain and water line connections on opposite side
Return line
Oil circulating system for thrust bearing

2" Extruder

compare with the covers off!

Yes, when you remove the covers and get down to the bare facts of construction of this unique extruder, you will find a machine which will have longer effective screw lengths, greater maximum heating capacity, and larger thrust bearing capacity. This will add up to higher production rates, better products, and lower maintenance and operating costs. With the flexible design of the "extrusion" unit consisting of the separate components; screw, heating cylinder, feed section; and thrust bearing housing, we can give you any combination to meet your requirements.

EGAN EXTRUDERS are supplied complete with a *wired* control panel including the main disconnect switch, fuse blocks, contacts and temperature controls *mounted*. Plumbing for the water supply and return lines to the drain are completed in the base. Installation costs are held to a minimum.

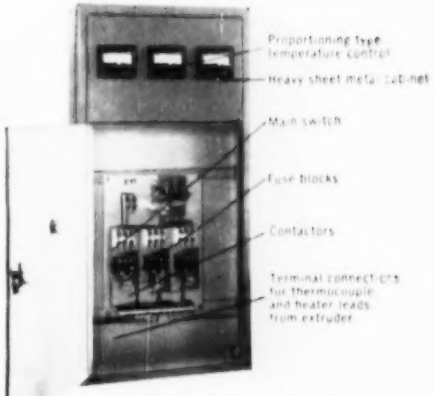
EGAN EXTRUDERS can be furnished with dies, conveyors, take-off equipment and other auxiliary features for a wide range of extruded products.

Write for details or invite our representative to call

FRANK W. EGAN & COMPANY, Bound Brook, New Jersey

Designers and Builders of Machinery for the Paper Converting and Plastics Industries

Cable Address: "EGANCO" — Bound Brook, N. J.



Control panel for 2" extruder completely wired

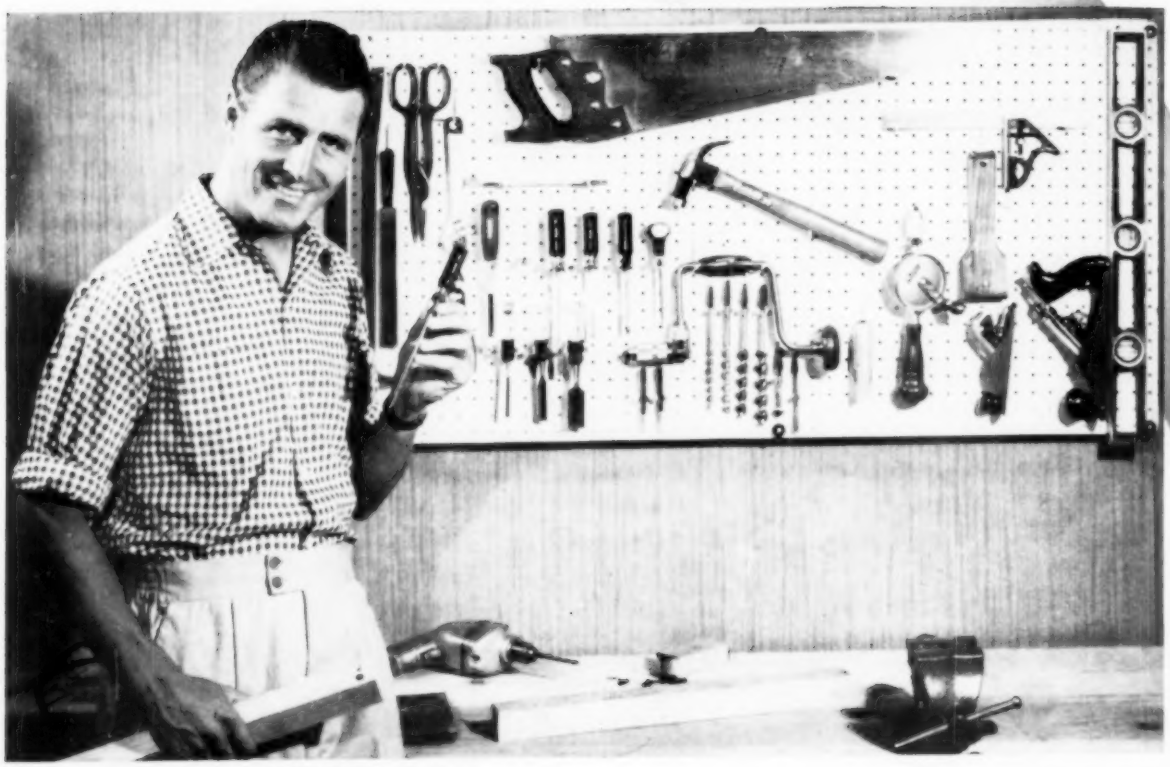
Compare specifications of any standard Egan Extruder, size for size, with any other extruder.

Standard Sizes (Screw Dia.)—inches	2	2½	3½	4½	6	8
Effective Screw Length—inches	32	40	56	72	96	128
No. Cylinder Sections	1	1	1	1	2	2
Zones of Heating on Cylinder	2	2	3	4	4	4
Maximum Heating Load, KW	12	18	30	48	96	160
Thrust Bearing Capacity, 1000 lbs. @ 50 rpm.	60.5	60.5	119.5	208	288	420
Type Speed Transmission	Worm gear.	Worm gear.	Herr' bone	Herr' bone	Herr' bone	Herr' bone
Usual Motor Size, H. P.	7½-10	10-15	20-30	40-50	50-75	75-150
Approx. Extrusion Capacity lb./hr.	20-50	40-90	75-200	150-450	250-650	450-1200
Approx. Floor Dimensions—inches	40x98	48x112	60x120	84x132	96x156	104x192
Approx. Weight—lbs. (less Drive)	3200	3600	4800	6600	9600	12500

**Extruders are modified to meet requirements for a particular process*

HERCULES® acetate

FOR PRODUCTS ON THE MOVE



This Stanley Handyman tool board set of popular-priced, do-it-yourself tools is sufficient to take care of practically any job the home owner might tackle. And the Handyman tool board is not only a quick-turnover, high-profit item but a compact, interest-catching display too.

Typical of the quality workmanship that goes into this Stanley tool set are the colorful and attractive handles of the screwdrivers and chisels. Fabricated from Hercules acetate, the handles not only add an eye-appealing feature to the set but have the toughness and durability necessary for long, hard use.

Whether you sell the Handyman tool board as a complete set of matched tools or with a partial selection of tools to the man who is outfitting his workshop "a tool at a time from the Handyman line," you can be sure of high profits and satisfied customers.

Handyman tools are an outstanding example of the competitively-priced, high-quality merchandise that moves faster from dealers' shelves, thanks to the eye-catching color and durability of Hercules plastics.

Chisel and screwdriver handles manufactured for Stanley Tools by S. A. Wetty Company with rod stock by Nixon Nitration Works based on Hercules cellulose acetate.

Cellulose Products Department

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